JUN 24 1929

AGRICULTURAL ENGINEERING

The Journal of the American Society of Agricultural Engineers

JUNE 1929

How Machinery Reduces Cotton Production Costs - - - - - - - *F. R. Jones*

Relation of Runoff to Vertical Interval of Terraces - - - - - - - - - *R. W. Baird*

Experiments on the Artificial Curing of Hay - - - *C. S. Nadler and C. L. Osterberger*

Developing Rural Electrification in the South - - - - - - - - - - *L. W. Gray*

Building Design for Southern Farm Conditions - - - - - - - - - *L. E. Hazen*

The Production of Peanuts with Power Machinery - - - - - - - - - *W. A. Clegg*

VOL.10 NO.6

JUN 24 1929

AGRICULTURAL ENGINEERING

The Journal of the American Society of Agricultural Engineers

JUNE 1929

How Machinery Reduces Cotton Production Costs - - - - - - - *F. R. Jones*

Relation of Runoff to Vertical Interval of Terraces - - - - - - - - - *R. W. Baird*

Experiments on the Artificial Curing of Hay - - - *C. S. Nadler and C. L. Osterberger*

Developing Rural Electrification in the South - - - - - - - - - - *L. W. Gray*

Building Design for Southern Farm Conditions - - - - - - - - *L. E. Hazen*

The Production of Peanuts with Power Machinery - - - - - - - - - *W. A. Clegg*

VOL. 10 NO. 6

SAVED Their Grain Crops

CASE Thresher owners saved their grain crops in the general floods of 1926, while their less fortunate neighbors suffered great losses. Ask C. W. Demling, Joseph Wurth, or Ben Pfeifer of Lincoln, Ill.

Harry Hubbard of Greenfield, Ark., had to haul his rice to his Case Thresher on mud boats, but he saved the whole crop.

Ownership of a Case Thresher enabled L. Baker of Woodstock, Ill., to save his own 200 acres of grain before the floods damaged it. Then he turned in to save what he could of his neighbor's weather-damaged grain.

Established 1842

A grain grower never knows when he is going to run into difficulties at threshing time. Somewhere there are always untimely rains, floods or early snows, and the profit from the grain crop is gone unless his thresher can handle wet, tough grain.

The built-in efficiency and dependability of Case machines give every user the advantage of better work at less expense under bad as well as favorable conditions.

This Company has prepared literature covering every phase of modern farming methods and equipment which will be sent gratis, on request, to any high school or college teacher. Write for sample set.

J. I. Case Co., Inc., Dept. F–2, Racine, Wis.

CASE

QUALITY MACHINES FOR PROFITABLE FARMING

AGRICULTURAL ENGINEERING

Published monthly by the American Society of Agricultural Engineers
Publication Office, Bridgman, Michigan. Editorial and Advertising Departments at the Headquarters of the Society, Saint Joseph, Michigan

Subscription price to non-members of the Society, $3.00 a year, 30 cents a copy; to members of the Society, $2.00 a year. Postage to countries to which second-class rates do not apply, $1.00 additional. Entered as second-class matter, October 8, 1925, at the post office at Bridgman, Mich., under the Act of August 24, 1912. Additional entry at St. Joseph, Mich. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized August 11, 1921. The title AGRICULTURAL ENGINEERING is registered in the U. S. Patent Office.

WILLIAM BOSS, President — RAYMOND OLNEY, Secretary-Treasurer

Vol. 10 — JUNE, 1929 — No. 6

CONTENTS

REDUCING COTTON PRODUCTION COSTS BY THE UTILIZATION OF IMPROVED MACHINERY 183
By F. R. Jones

THE RELATION OF RUNOFF TO VERTICAL INTERVAL OF TERRACES 188
By R. W. Baird

CONTROL OF EROSION IN OKLAHOMA 190
By G. E. Martin

EXPERIMENTS ON THE ARTIFICIAL CURING OF HAY 191
By C. S. Nadler and C. L. Osterberger

RURAL ELECTRIC DEVELOPMENT IN THE SOUTH 193
By L. W. Gray

BUILDING DESIGN FOR SOUTHERN CONDITIONS 195
By L. E. Hazen

NEW DESIGNS FOR SOUTHERN FARM BUILDINGS 197
By Deane G. Carter

SOME RECENT DEVELOPMENTS IN RURAL ELECTRIFICATION 198
By E. C. Easter

PRODUCTION OF PEANUTS WITH POWER MACHINERY 199
By W. A. Clegg

PRODUCING CORN AND SOYBEANS WITH MECHANICAL POWER 201
By C. L. Osterberger

A STUDY OF FARM HOUSE COSTS 203
By Deane G. Carter

AGRICULTURAL ENGINEERING DIGEST 205

EDITORIALS 206

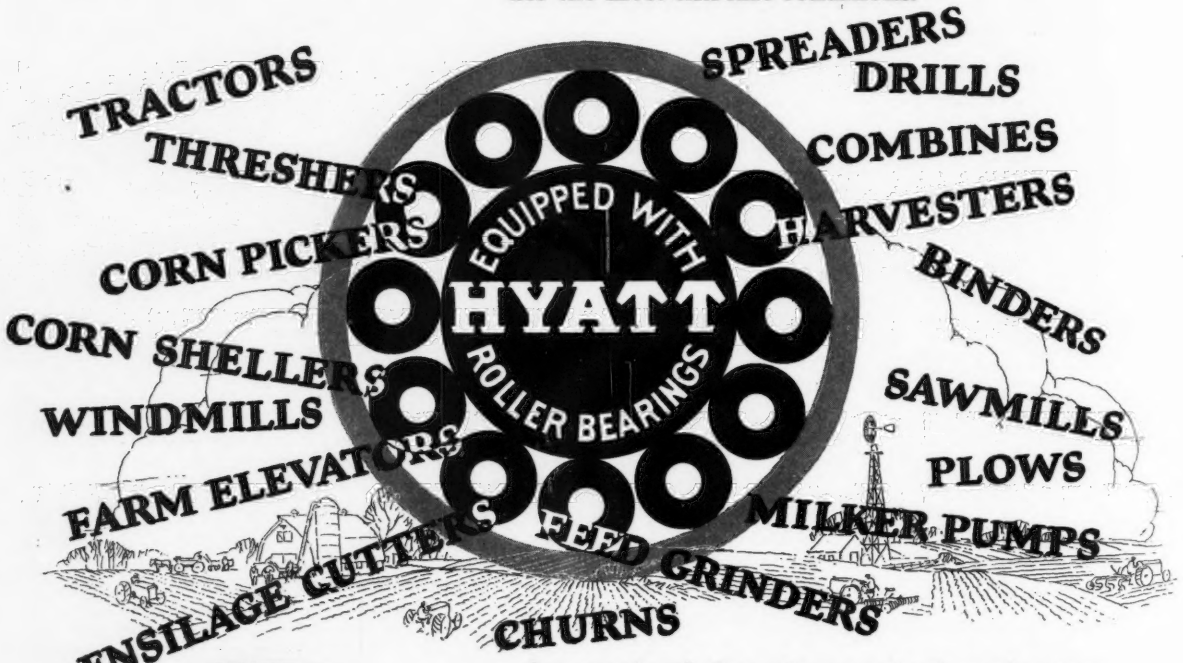
WHO'S WHO IN AGRICULTURAL ENGINEERING 207

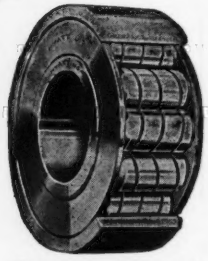
A.S.A.E. AND RELATED ACTIVITIES 208

Good Equipment and Good Bearings *are Inseparable . . .*

To TRACTORS, combines, threshers, ensilage cutters, windmills, spreaders and all other equipment, Hyatt Roller Bearings bring freedom from bearing cares.

Pounding, incessant operation imposes excessive demands on the vital working parts of farm machinery. But when they are Hyatt protected satisfactory bearing performance is assured under the most extreme conditions.





Hyatt Roller Bearing with outer race cut away to show roller construction.

An occasional shot of grease is the only attention Hyatts ever require in their many years of saving and serving. Hyatt distinctive design is responsible for their ability to absorb shocks and strains, their freedom from constant lubrication, and need of ever requiring adjustment.

That is why builders of good farm equipment employ these better bearings. And that is why you can have confidence in Hyatt equipped machines.

HYATT ROLLER BEARING COMPANY

Newark Detroit Chicago Pittsburgh Oakland

HYATT

ROLLER BEARINGS

PRODUCT OF GENERAL MOTORS

AGRICULTURAL ENGINEERING

Vol. 10 JUNE, 1929 No. 6

Reducing Cotton Production Costs by the Utilization of Improved Machinery[1]

By F. R. Jones[2]

CHANGING economic conditions in agriculture such as higher labor costs and increased land values, and, in addition, unfavorable weather, have made cotton farming as well as grain and livestock farming more or less unprofitable during the past few years. The result has been a stimulation of study and interest on the part of the cotton grower, particularly concerning possible methods of meeting and successfully overcoming such conditions.

A number of conditions and factors have developed in the past few years which seem destined to have a marked influence upon the prevailing practices in growing cotton particularly in the older cotton-growing sections. Some of these are:

1. The increased cost of reliable hand labor
2. The constantly fluctuating and very uncertain price of cotton
3. Increased land values and higher taxes
4. The development of successful and reliable all-purpose tractors and tractor-drawn implements adapted to cotton growing
5. The possible development of a successful mechanical cotton picker or gathering device
6. The possible development of a cheaper and faster method of thinning cotton or the elimination of the thinning operation entirely by thinner planting of the seed
7. The opening up of new and somewhat remote cotton-growing areas in certain states, particularly in Texas, in which a plentiful supply of cheap labor is not available and is not likely to be in the future due to geographic, climatic and other conditions

[1]Paper presented at a joint meeting of the Southern and Southwest Sections of the American Society of Agricultural Engineers at Houston, Texas, February, 1929.

[2]Associate professor of agricultural engineering, A. & M. College of Texas. Assoc. Mem. A.S.A.E.

Tractor equipped with duster attachment in use in a Texas cotton field

Conditions Peculiar to Cotton Growing. Unlike corn, cotton production involves two operations which, at the present time, can be accomplished only by hand. One of these is the thinning or chopping process, and the other is the picking or gathering of the mature crop. Both of these operations must be done in as short a time as possible to insure a profitable crop, and consequently require that a comparatively large number of laborers be available—a considerably greater number than are necessary to handle the other growing operations. Fortunately, this need for comparatively cheap labor particularly for chopping and picking cotton, has been rather adequately supplied by the negro and Mexican population of the more important cotton-growing states.

Again this condition, which requires an excess of hand labor for the two operations mentioned, has, no doubt, been largely responsible for the widespread share cropping system which has been practiced to a large extent throughout the cotton belt for many years. The landowner, realizing the need of an excess of cheap hand labor at chopping and picking time, has found it more profitable to rent out his land in comparatively small tracts which can easily be taken care of by the tenant and his family rather than to work all of his land himself with hired labor and depend upon being able to obtain extra hands at chopping and picking time.

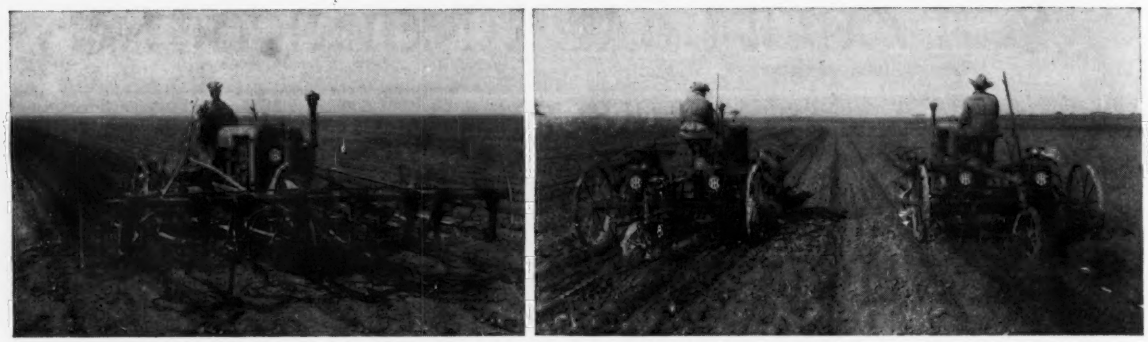
Likewise this system of cotton growing has had a tendency to encourage the use of simple one and two-horse implements rather than larger machines which would do the work just as well and do it faster. The contention is that these small machines are simple and inexpensive and therefore give better results in the hands of irresponsible operators. Larger machines drawn by two, three or four horses, or tractor outfits, would cost more and give more trouble in the hands of unskilled operators, it is claimed.

Consider for a moment the operations involved in the growing of a cotton crop. These operations and the usual order in which they are carried out are as follows:

1. Preparation of the land
   (a) Stalk disposal
   (b) Plowing
   (c) Harrowing
2. Planting
3. Thinning or chopping
4. Cultivating
5. Insect control
6. Picking
7. Ginning

Prevailing Conditions and Practices. The first operation in the preparation of cotton land is usually stalk disposal, especially where cotton follows cotton. Some of the common methods of stalk disposal are as follows:

1. Using the ordinary rotating-knife stalk cutter. This machine handles the stalks satisfactorily if they are not too high or too green. As a rule, however, it is not used to any great extent where cotton grows tall and rank.
2. Cutting the stalks, raking and burning. This meth-



(Left) Farmall tractor cultivating cotton in rows one-half mile long. (Right) Two Farmall tractors planting cotton (two rows at a time each) in Texas

od of stalk disposal is resorted to extensively where the cotton grows tall. However, there are two objections to it. It involves considerable labor and expense and it deprives the land of the fertilizing value of the stalks.

3. The use of special stalk cutters in certain localities.
4. The use of the disk harrow.

A reliable and not too expensive machine capable of thoroughly cutting up or shredding cotton stalks of any size as they stand in the field and leaving them in such condition that they would not interfere with succeeding operations, would be greatly welcomed by cotton growers.

Seedbed Preparation. There is considerable variation in the method of preparing the seedbed for cotton in different sections. In many cases the land is bedded. In others it is prepared flat. The practice depends to a large extent upon soil and weather conditions.

It is doubtful if the bedding method should be practiced as extensively as it is, but it seems to be necessary in many cases in certain types of soil and in poorly drained land, in order to hasten the drying of the soil and keep the seed out of the water in case of excessive rainfall immediately after planting.

It is possible to prepare the land more cheaply by bedding than flat, especially if it is not rebedded. When rebedding is done, it is doubtful if there is any saving.

Planting. Planting of cotton is done in a number of ways, varying from the use of simple one-row walking planter to the one and two-row standard type cotton planters equipped with a front standard and a large sweep. This is the type of planter usually used for bedded land. For planting flat land the same type of planter may be used but it seems possible that the two-row, open-wheel type of planter, such as that used for planting corn, should be used more extensively. This planter is lighter in draft and will do excellent work on land that is well prepared.

Thinning and Chopping. As already mentioned, thinning of the cotton, or chopping as it is more commonly known, is done almost entirely by hand and thus far has been one of the more expensive operations in the production of the cotton crop. This problem will be discussed later.

Cultivation. The cultivation of the cotton crop is handled by several devices varying from a Georgia stock with a small sweep requiring two or three rounds per row to the one and two-row, riding, horse-drawn cultivators. The cultivation of the growing crop is important in weed control and in maintaining a soil mulch to hold the moisture. Cultivation can be materially reduced in cost and at the same time be done just as conveniently and satisfactorily with one and two-row machines as with these simpler tools. The cotton grower who expects to operate at a profit in the future must give more consideration to the problem of cultivation.

Insect Control. Insect control has become one of the important problems in the production of the cotton crop. Great strides have been made during the past few years in the control of cotton pests and efficient labor-saving machines adapted to any size of farm are now available. Where cotton is raised on a large scale, the control of insects by airplane is now proving very successful.

Picking. The gathering of the mature cotton is perhaps the most expensive operation in the production of the crop. Much time, thought, and money are being spent on this problem at the present time and it seems safe to predict that cheaper and faster methods of picking cotton will be worked out in the near future.

Ginning. Although the ginning of cotton is a rather expensive operation, it cannot be greatly improved upon except in minor details such as in handling trashy cotton, snapped cotton and so on.

SECTIONS ADAPTED TO MACHINE PRODUCTION

Of course it is quite apparent, and naturally so, that the use of larger power units and improved machinery is receiving its initial impetus and success only in certain cotton-growing sections, that is, in those sections especially suited to the use of larger machine units. The particular characteristics of these sections are:

1. Fields are comparatively large and regular in shape, thus permitting long, straight rows
2. The land is unusually fertile and productive and will produce a good cotton crop every year, provided weather conditions are favorable
3. In topography the land is flat or only slightly rolling
4. Fields are free from stumps and trees
5. Soil conditions are comparatively uniform.

In an effort to obtain further information concerning the adoption of mechanical power for cotton production, letters of inquiry were sent to all southern branch houses of the principal farm equipment manufacturers now marketing an all-purpose tractor and equipment to any extent throughout the cotton belt. The replies to these letters brought out that the demand, at the present time, was limited largely to the following states and sections:

1. The Mississippi River delta lands in the states of Arkansas, Louisiana, Mississippi and Tennessee
2. The state of Texas in the following sections:
   (a) Lower Rio Grande Valley
   (b) The coastal plains section, in the vicinity of Corpus Christi and Robstown
   (c) The low and high plains sections of western Texas
   (d) The black land belt in north, north central, west central and central Texas.

The inquiries indicated only a slight interest thus far in the adoption of mechanical power in the older cotton-growing sections in such states as Alabama, Georgia and the Carolinas. Apparently where the old and well-known tenant system of cotton growing has existed for many years, the transition is going to be extremely slow, even where soil and topographic conditions are satisfactory.

USE, ADAPTABILITY AND CAPACITY OF MECHANICAL POWER AND LARGE MACHINE UNITS

A survey made in the Corpus Christi and San Angelo sections of Texas in December 1926 was the first study of any consequence made of the use of mechanical power for cotton production. The results of this study were published as Bulletin No. 362 of the Texas Agricultural Experiment Station.

This study did not include a determination of the net profit or loss per pound and per acre on tractor-operated farms as compared with horse-operated farms, but it was confined principally to a comparison of the capacity of animal and tractor power and the implements commonly used. Among other things the study brought out the following:

1. One tractor with two-row equipment will easily replace 4 horses
2. One tractor with two-row equipment is capable of handling 100 acres of cotton up to picking, whereas most farmers were of the opinion that 4 horses could handle only about 80 acres
3. One tractor with four-row planting and cultivating equipment is capable of handling 200 acres of cotton up to picking. A similar acreage requires 10 to 12 horses

In addition to the above the survey indicated that the trend in the Corpus Christi section was toward the four-row planting and cultivating equipment rather than the two-row or the six-row. In the San Angelo section of Texas two-row equipment was used at the time of the survey. The indications were that this trend would continue, due largely to the smaller size of the fields, character of the land and system of farming.

In order to obtain further definite information concerning the cost of operation of all-purpose tractors in growing cotton a project was carried out near College Station in the Brazos Valley during the past season. A 125-acre field was divided into two plots. One plot of 57.7 acres was operated with a Fordson tractor and Kelley Plow Company two-row equipment. The other plot of 68.15 acres was operated with a Farmall tractor and two-row equipment. In carrying out this project, a number of handicaps were encountered, such as blind stumps, shallow ditches to be crossed, and unfavorable weather. Consequently the results obtained are far from startling. However, they do give us something definite and are fairly representative of what is to be expected with two-row tractor equipment in cotton growing. The data obtained is given and summarized in the accompanying tables.

In determining the cost of producing the crop the following items were considered:

1. Fuel
2. Lubricating oil
3. Transmission lubricant
4. Cup grease
5. Repair parts for tractor and equipment
6. Blacksmith labor
7. Tractor repair labor (when not in field)
8. Labor for changing equipment
9. Tractor operator
10. Man to fill seed cans when planting
11. Interest on investment in tractor and equipment
12. Depreciation
13. Seed for planting
14. Chopping

TABLE I. PERFORMANCE DATA ON THE FARMALL TRACTOR

Operation	Total hr. required	Fuel used, gal.	Lubricating oil used, qt.	Acres per hr.	Tractor hr. per acre	Man-hr. per acre	Fuel used per acre gal.
Disking	45.17	76.75	10	1.51	0.663	0.663	1.16
Seeding	49.36	86.50	10	1.38	0.725	0.725	1.30
Planting - 1st time	36.36	62.25	10	1.78	0.562	1.124*	0.91
Planting - 2nd time	38.75	56.00	9.5	1.50	0.666	1.332*	0.96
Cultivating - 10 acres - 1st time	5.00	7.50		2.00	0.500	0.500	0.75
Cultivating - 10 acres - 2nd time	5.50	7.50		1.82	0.550	0.550	0.75
Cultivating - entire tract	39.58	50.65	10	1.72	0.583	0.583	0.74
Cultivating - entire tract	41.06	59.00	3	1.46	0.603	0.603	0.78
Cultivating - entire tract	39.56	50.50	9	1.72	0.583	0.583	0.83
Cultivating - entire tract	37.00	51.35	2	1.84	0.543	0.543	0.75
Cultivating - entire tract	35.00	49.35	2	2.06	0.484	0.434	0.72
Cultivating - last time - 15 acres	25.80	34.50	7	2.08	0.480	0.480	0.66
Total	397.66	595.65	78.5		6.940	8.168	

*Extra man used to fill seed cans

TABLE II. PERFORMANCE DATA ON THE FORDSON TRACTOR

Operation	Total hr. required	Fuel used, gal.	Lubricating oil used, qt.	Acres per hr.	Tractor hr. per acre	Man-hr. per acre	Fuel used per acre gal.
Disking	34.66	73.50	10	1.60	0.625	0.625	1.27
Seeding	48.00	81.50	10	1.20	0.832	0.832	1.41
Planting - 1st time	37.30	48.50	9	1.54	0.650	1.300*	1.06
Planting - 2nd time	41.75	70.00	10	1.38	0.723	1.450*	1.21
Cultivating - entire tract	44.00	53.00	11	1.31	0.762	0.762	0.92
Cultivating - entire tract	43.50	60.50	3	1.19	0.840	0.840	1.05
Cultivating - entire tract	36.48	55.00	11	1.50	0.666	0.666	0.95
Cultivating - entire tract	33.48	53.00	3	1.73	0.579	0.579	0.92
Cultivating - entire tract	33.33	45.00	3	1.73	0.579	0.579	0.78
Cultivating - entire tract	34.33	44.00	9	1.68	0.596	0.596	0.76
Total	396.33	596.00	78		6.851	8.234	

*Extra man used to fill seed cans

TABLE III. Statement of Income and Expenses

Farmall Tractor

Income	
17,306 lb. lint cotton at 20 cents per lb.	$3,461.20
31,151 lb. seed at $40.00 per ton	623.02
	$4,084.22
Expenses	
595.65 gal. fuel at 17 cents per gal.	$ 101.26
18.13 gal. lubricating oil at 65 cents per gal.	11.78
9 gal. transmission lubricant at $1.00 per gal.	9.00
8 lb. cup grease at 15 cents per lb.	1.20
Repair parts for tractor and equipment	8.00
Blacksmith labor, 27¾ hr. at 75 cents per hr.	20.81
Changing tools, 11 hr. at 20 cents per hr.	2.20
Tractor operator, 397.66 man-hr. at 20 cents per hr.	79.53
19.88 man-hr. labor (1/20 time added for adding fuel water, oil, etc.) 20 cents per hr.	3.98
Man to fill seed cans, 77 hr. at 15 cents per hr.	11.55
Interest on investment in tractor and equipment at 6 per cent	95.70
Depreciation on tractor and equipment, 20 per cent	319.00
Seed for planting, 127.78 bu. at $3.00 per bu.	383.34
Chopping three times	253.63
Poisoning and insect control, 15 acres at 60 cents per acre, (two applications)	18.00
Picking 48,457 lb. seed cotton at $1.00 per cwt.	484.57
Ginning 17,306 lb. lint cotton at 90 cents per cwt.	155.75
Bagging and ties, 33 bales at $2.00 per bale	66.00
Taxes on land, 68.15 acres at $1.00 per acre	68.15
	$2093.45

Fordson Tractor

Income	
16,080 lb. lint cotton at 20 cents per lb.	$3,216.00
28,944 lb. seed at $40.00 per ton	578.88
	$3,794.88
Expenses	
598 gal. fuel at 17 cents per gal.	$ 101.66
19.50 gal. lubricating oil at 65 cents per gal.	12.68
3¾ gal. transmission lubricant at $1.00 per gal.	3.75
3 lb. cup grease at 15 cents per lb.	0.45
Repair parts for tractor and equipment	81.25
Blacksmith labor, 29¾ hr. at 75 cents per hr.	22.31
Tractor repair, 4 hr. at $1.00 per hr.	4.00
Changing tools, 16½ hr. at 20 cents per hr.	3.30
Tractor operator, 395.33 man-hr. at 20 cents per hr.	79.07
19.77 man-hr. labor (1/20 of time added for adding fuel, water, oil, etc.) 20 cents per hr.	3.95
Man to fill seed cans, 79.25 hr. at 15 cents per hr.	11.89
Interest on investment in tractor and equipment, 6 per cent	76.80
Depreciation on tractor and equipment, 20 per cent	256.00
Seed for planting, 108.21 bu. at $3.00 per bu.	324.62
Chopping three times	214.77
Picking, 45024 lb. seed cotton at $1.00 per cwt.	450.24
Ginning, 16080 lb. lint cotton at 90 cents per cwt.	144.72
Bagging and ties, 33 bales at $2.00 per bale	66.00
Taxes on land, 57.71 acres at $1.00 per acre	57.71
	$1915.17

TABLE IV. Summary

Farmall Tractor

Fuel used per acre	8.74 gal.
Yield of seed cotton per acre	711.00 lb.
Yield of lint cotton per acre	254.00 lb.
Gross income per acre	$59.93
Cost of producing crop per acre	$30.72
Net income per acre	$29.21
Cost of producing crop per pound lint cotton	12.10 cents
(Based on tractor work only, Items 1 to 12 in list of cost items)	
Cost of producing crop per acre	$9.74
Cost of producing crop per pound lint cotton	3.84 cents

Fordson Tractor

Fuel used per acre	10.36 gal.
Yield seed cotton per acre	780.00 lb.
Yield lint cotton per acre	279.00 lb.
Gross income per acre	65.76
Cost of producing crop per acre	$33.19
Net income per acre	$32.57
Cost of producing crop per pound lint cotton	11.91 cents
(Based on tractor work only, Items 1 to 12 in list of cost items)	
Cost of producing crop per acre	$11.39
Cost of producing crop per pound lint cotton	4.09 cents

Both Tractors Combined

Fuel used per acre	9.48 gal.
Yield seed cotton per acre	743.00 lb.
Yield lint cotton per acre	265.00 lb.
Gross income per acre	$62.60
Cost of producing crop per acre	$31.85
Net income per acre	$30.75
Cost of producing crop per pound lint cotton	12.01 cents
(Based on tractor work only, Items 1 to 12 in list of cost items)	
Cost of producing crop per acre	$10.49
Cost of producing crop per pound lint cotton	3.96 cents
Chopping, per cent of total cost	11.63
Picking, per cent of total cost	23.32
Tractor work, per cent of total cost	32.96
Other work such as ginning, planting seed, taxes, etc., per cent of total cost	32.09

TABLE V. Combined Income and Cost Statement

(Based upon the same acreage and a yield of one bale (500 lb.) of lint cotton per acre, and the same operating expenses as those incurred in this project with the two tractors combined.)

Income	
62930 lb. lint cotton at 20 cents per lb.	$12,586.00
113274 lb. seed at $40.00 per ton	2,265.48
	$14,851.48
Expenses	
1193.65 gal. fuel at 17 cents per gal.	$ 202.92
37.63 gal. lubricating oil at 65 cents per gal.	24.46
12.75 gal. transmission lubricant at $1.00 per gal.	12.75
11 lb. cup grease at 15 cents per lb.	1.65
Repair parts for tractors and equipment	89.25
Blacksmith labor, 57½ hr. at 75 cents per hr.	43.12
Changing tools, 27½ hr. at 20 cents per hr.	5.50
Tractor repair, 4 hr. at $1.00 per hr.	4.00
Tractor operators, 792.99 hr. at 20 cents per hr.	158.60
39.65 man-hr. labor (1/20 additional time for adding water, fuel and lubricating oil) at 20 cents per hr.	7.93
Man to fill seed cans, 156.25 hr. at 15 cents per hr.	23.44
Interest on investment in tractor and equipment at 6 per cent	172.50
Depreciation on tractor and equipment at 20 per cent	575.00
Seed for planting, 235.99 bu. at $3.00 per bushel	707.96
Chopping three times	468.40
Poisoning and insect control	18.00
Picking 176,204 lb. seed cotton at $1.00 per cwt.	1762.04
Ginning 62,930 lb. lint cotton at 90 cents per cwt.	566.37
Bagging and ties, 126 bales at $2.00 per bale	252.00
Taxes on land, 125.86 acres at $1.00 per acre	125.86
	$5221.75

Summary

Gross income per acre	$118.00
Cost of producing crop per acre	$41.49
Net income per acre	$76.51
Cost of producing crop per pound lint cotton	8.30 cents
(Based on tractor work only, Items 1 to 12 in list of cost items)	
Cost of producing crop per acre	$10.50
Cost of producing crop per pound lint cotton	2.10 cents

15. Poisoning and insect control
16. Picking
17. Ginning
18. Bagging and ties
19. Taxes on land

For the purpose of determining the interest on the investment and the depreciation, the following values as submitted by the manufacturers and local dealers, were given to the tractors and equipment:

Farmall tractor	$1,075.00
Tandem disk harrow, 7-foot	150.00
Two-row middlebuster	95.00
Two-row planter	150.00
Two-row cultivator	125.00
Total	$1,595.00
Fordson tractor	$ 550.00
Wehr manifold and Waukesha cylinder head for tractor	100.00
Bosch high tension magneto with impulse starter coupling	85.00
Tandem disk harrow, 7-foot	150.00
Kelly two-row middlebuster attachment	120.00
Kelly two-row planter attachment	55.00
Kelly two-row cultivator attachment	140.00
Extension axle and front wheel rig	80.00
Total	$1,280.00

RESULTS

1. The area covered per hour by the Farmall varied from 1.38 acres in bedding to 2.08 acres in cultivating. For the Fordson it varied from 1.20 acres in bedding to 1.73 acres in cultivating. This indicates that bedding is the heaviest operation and cultivating is the lightest. It is true that only 1.19 acres per hour were cultivated by the Fordson at the second cultivation. This was due to changing drivers. The new man held the tractor speed down rather low.

2. Production of the crop, including all tractor operations, required 6.94 tractor-hours per acre with the Farmall tractor and 6.85 tractor-hours per acre with the Fordson.

3. The labor required for doing the tractor work was 8.168 and 8.224 man-hours for the Farmall and Fordson, respectively. The man-hours are greater than the tractor-hours because an extra man was used to fill the seed cans in planting. It is doubtful if this is necessary.

4. The fuel used per acre by the Farmall varied from 1.30 gallons in bedding to 0.65 gallon in cultivating. For the Fordson it varied from 1.41 gallons in bedding to 0.76 gallon in cultivating. This indicates again that bedding requires the greatest amount of power and cultivating the least where two-row equipment is used entirely. In fact, in each case the bedding operation appears to require practically double the amount of fuel and power that is required for cultivation.

5. The yield of cotton per acre was slightly more than one-half bale on the basis of 500 pounds of lint cotton per bale. This yield was about the same as that obtained from the cotton raised with animal power on this farm. This land is capable of producing three-fourths to one bale of cotton per acre, provided weather conditions are favorable and rainfall is normal and properly distributed.

6. A difference in yield of 25 pounds per acre for the two tractor plots can probably be attributed to a difference in stand obtained. This variation in stand was due largely to a variation in soil and moisture conditions in different parts of the field at planting time.

7. The cost of producing the crop per acre, considering all items, was $59.93 for the Farmall and $65.76 for the Fordson.

8. Although the Farmall plot showed a lower cost of production per acre, the cost per pound of lint cotton was slightly higher, due to a lower yield. The cost per pound of lint cotton of producing the crop was practically 12 cents in each case.

9. Based on the cost of the tractors and their operation only, the cost of producing the crop per acre was $9.74 for the Farmall and $11.39 for the Fordson. On a

similar basis, the Farmall tractor produced the crop at a cost of 3.84 cents per pound of lint cotton and the Fordson at a cost of 4.09 cents.

10. The tractor work made up approximately 33 per cents or one-third of the total cost of producing the crop. Chopping accounted for 11.63 per cent and picking 23.32 per cent of the total cost.

11. Table V indicates that if there had been a yield of one bale—500 pounds of lint cotton—per acre, the cost of producing the crop would have increased about $9.64, whereas the gross income would have been $55.40 greater. Likewise, on this basis, the cost of producing a pound of lint cotton would have been 8.3 cents instead of 12.1 cents, or about one-third less.

12. Table VI indicates that with one tractor handling 100 acres and a yield of one-half bale per acre, the costs of production of the crop per acre and per pound of lint are approximately $25.00 and 10 cents, respectively.

13. Table VII indicates that with one tractor handling 100 acres and a yield of one bale per acre, the cost of production of the crop per acre and per pound of lint is approximately $35.00 and 7.01 cents, respectively.

14. Tables V and VII likewise show the importance and advantage of a high yield over a low or average yield. In other words, the cost of producing a high yielding crop is very little more than the cost of producing a crop of average yield.

SUMMARY

1. It is doubtful if the present methods of land preparation in certain sections where mechanical power is utilized are the best methods. There is a great need for a more satisfactory method of disposing of the old cotton stalks. Perhaps a machine could be developed which would dispose of the stalks and plow the land at the same time. In sections where the land is prepared flat instead of bedded, the recently developed wheatland disk plow is being used to a considerable extent. Perhaps this plow could be used successfully in other sections.

2. In general tools used in land preparation require about twice as much power as the two-row planters and cultivators. Therefore, the trend will likely be toward three and four-row planting and cultivating equipment. In fact in the Corpus Christi section of Texas, it is reported that 90 per cent of this equipment now being purchased is of the four-row type. In the Mississippi River delta lands it is reported that nearly 50 per cent of the planting and cultivating equipment is being purchased in the four-row size. Where the land is level and uniform and long, straight rows are possible there is no doubt as to the advantage of these four-row tools. They enable the farmer to get his crop planted and cultivated in a very short time, which is a particularly important item for these two operations.

3. Considerable progress has already been made toward eliminating hand chopping and hand picking. The chopping problem is being approached in two ways as follows:

1. Planting the seed in hills properly spaced in the row, and thin enough to eliminate thinning after the plants appear
2. Planting the seed in the usual manner and thinning the young plants by mechanical means

Both ideas have their advantages, and enough progress has not been made as yet to predict developments. Here in Texas the use of the common beet cultivator for thinning cotton, by going crosswise of the rows, has been tried extensively in several sections and has given encouraging results. The shanks of the cultivator are equipped with small sweeps so spaced that they give the proper spacing of the plants. A county agent in the Corpus Christi territory has the following to say regarding thinning cotton by cross-plowing:

"With reference to eliminating hand chopping I think we have made valuable steps during the last two years. Two years ago when labor was hard to obtain at chopping time we devoted quite a bit of attention to cross-plowing with two-row cultivators using eight and ten-inch sweeps, which proved satisfactory. The ten-inch sweep gave the best results. That year about 25,000 acres were cross-plowed or chopped in this way. Another apparatus used the same year was a 4x4-inch beam attached to a planter or cultivator and upon which sweep shanks were bolted and used to cross-plow the cotton. This was

TABLE VI. Set-up Using One Tractor Operating 100 Acres and Assuming a Yield of One-half Bale Per Acre

Income	
25000 lb. lint cotton at 20 cents per lb.	$5,000.00
45000 lb. seed at $40.00 per ton	900.00
	$5,900.00
Expenses	
Fuel, 8.75 gal. per acre at 17 cents per gal.	$ 148.75
30 gal. lubricating oil at 65 cents per gal.	19.50
10 gal. transmission lubricant at $1.00 per gal.	10.00
10 lb. cup grease at 15 cents per lb.	1.50
Repair parts for tractor	50.00
Blacksmith labor, 40 hr. at 75 cents per hr.	30.00
Tractor repair labor, 10 hr. at $1.00 per hr.	10.00
Changing tools, 15 hr. at 20 cents per hr.	3.00
Tractor operator, 6 hr. per acre, including time for adding fuel, water, lubricating oil and filling seed cans at 20 cents per hr.	120.00
Interest on investment in tractor and equipment at 6 per cent	95.70
Depreciation on tractor and equipment at 20 per cent	319.00
Seed for planting, 1 bu. per acre at $3.00 per bushel	300.00
Chopping two times, at $1.25 per acre per time	250.00
Picking 70,000 lb. seed cotton at $1.00 per cwt.	700.00
Ginning 25,000 lb. lint cotton at 90 cents per cwt.	225.00
Bagging and ties, 50 bales at $2.00 per bale	100.00
Taxes on land at $1.00 per acre	100.00
	$2482.45
Summary	
Gross income per acre	$59.00
Cost of producing crop per acre	$24.82
Net income per acre	$34.18
Cost of producing crop per pound lint cotton	9.93 cents
(Based on tractor operation only, Items 1 to 12 in list of cost items)	
Cost of producing crop per acre	$8.07
Cost of producing crop per pound lint cotton	3.23 cents

TABLE VII. Set-up Using One Tractor Operating 100 Acres and Assuming a Yield of One Bale Per Acre

Income	
50,000 lb. lint cotton at 20 cents per lb.	$10,000.00
90,000 lb. seed at $40.00 per ton	1,800.00
	$11,800.00
Expenses	
Fuel, 8.75 gal. per acre at 17 cents per gal.	$ 148.75
30 gal. lubricating oil at 65 cents per gal.	19.50
10 gal. transmission lubricant at $1.00 per gal.	10.00
10 lb. cup grease at 15 cents per lb.	1.50
Repair parts for tractor	50.00
Blacksmith labor, 40 hours at 75 cents per hr.	30.00
Tractor repair labor, 10 hr. at $1.00 per hr.	10.00
Changing tools, 15 hr. at 20 cents per hr.	3.00
Tractor operator, 6 hr. per acre, including time for adding water, fuel, lubricating oil, and filling seed cans at 20 cents per hr.	120.00
Interest on investment in tractor and equipment at 6 per cent	95.70
Depreciation on tractor and equipment at 20 per cent.	319.00
Seed for planting, 1 bu. per acre at $3.00 per bu.	300.00
Chopping two times at $1.25 per acre per time	250.00
Picking 140,000 lb. seed cotton at $1.00 per cwt.	1400.00
Ginning 50,000 lb. lint cotton at 90 cents per cwt.	450.00
Bagging and ties for 100 bales at $2.00 per bale	200.00
Taxes on land at $1.00 per acre	100.00
	$3507.45
Summary	
Gross income per acre	$118.00
Cost of producing crop per acre	$35.07
Net income per acre	$82.93
Cost of producing crop per pound lint cotton	7.01 cents
(Based on tractor work only, Items 1 to 12 in list of cost items)	
Cost of producing crop per acre	$8.07
Cost of producing crop per pound lint cotton	1.62 cents

also satisfactory and covered more ground than the double-row cultivators.

"Since that time various patent cotton choppers have been used such as the rotary chopper which consists of a system of harrow-like spikes mounted on a round wheel which is suspended from a cultivator. This machine has not been altogether satisfactory but is being used some. Several other machines of the patent drum type have been introduced, but none of them have been accepted by the farmers in this section. In fact, the cross-plow mentioned above has been accepted as the most practical mechanical chopper thus far produced. This practice necessitates, of course, a perfect stand of cotton, which we are very fortunate in having four out of five years. It is inexpensive; we figure that cross-plowing can be done for 10 cents an acre."

The leading implement companies report that the indications point toward a greatly increased demand for these beet cultivators for this season.

Mechanical cotton picking likewise is receiving a great deal of attention and thought at this time, but up to this time has not been definitely solved. The problem is being approached in two ways and it seems likely that one of them or perhaps both will eventually prove successful. These are:

1. The construction of a machine which will remove the cotton fiber and seed from the boll on the plant so that it goes to the gin in the same condition as when hand picked.

2. The construction of a machine which will strip or remove the cotton together with the boll from the plant, the cotton to be removed from the boll and cleaned at the gin by means of special gin equipment.

What is the significance of this mechanization of cotton production? It is simply that cotton is going to be produced more cheaply than ever before in those sections previously mentioned which are especially adapted to the successful use of large machine units. If these sections are extended eventually to include sufficient acreage to supply the demand upon this country for raw cotton, then the small cotton grower or operator of land less suited to mechanical power and large machine units is going to be greatly handicapped in operating at a profit.

The Relation of Runoff to Vertical Interval of Terraces[1]

By R. W. Baird[2]

ONE of the problems in the laying out of any system of terraces is the determination of the correct vertical distances between terraces for any given field slope.

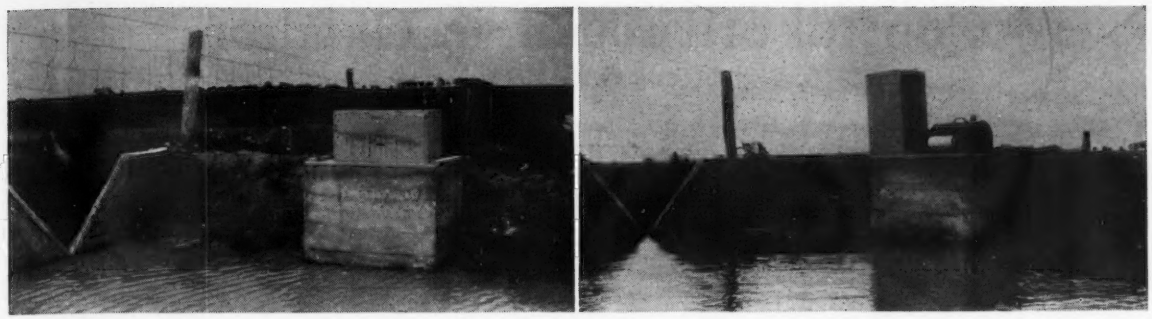
During the summer of 1927 we constructed a number of terraces, each of which had a different vertical interval, but each laid out with the variable grade that we have been recommending for Oklahoma. At the outlet of each of these terraces there has been installed a 90-degree, V-notch weir and an automatic recording gage that measures at all times the height of water flowing over the weir. From this record the total amount of runoff from each terrace is determined.

Then in order to get some idea of the amount of suspended matter carried by the runoff water, a sampling tank was placed at some distance below the weir and a ½-inch pipe put through the terrace at the level of the weir notch. Any time that there is water flowing over the weir there is some water flowing into the sampling tank, the amount depending upon the head of water over the weir crest. At any time the water in the tank can be thoroughly

[1]Paper presented at a joint meeting of the Southern and Southwest Sections of the American Society of Agricultural Engineers, at Houston, Texas, February, 1929.

[2]Assistant professor of agricultural engineering, Oklahoma A. & M. College. Jun. Mem. A.S.A.E.

Building terraces with modern equipment. A terrace 25 feet wide and 20 inches high can be built at the rate of 100 feet in 25 minutes



(Left) Gaging Station No. 1, showing weir and outlet pipe for collecting samples of runoff water. (Right) Gaging Station No. 3, with gage cover removed to show gage

stirred and a sample of it taken. A determination of the amount of solid material carried by the water is made from this sample. From this determination and the runoff record we are able to determine the amount of solid material carried over the weir by the runoff water.

Records for the past year have been obtained from three terraces. One of these has a four-foot interval, one a three-foot interval and one a two-foot interval. All are laid out with a variable grade of level for 100 feet; ½ inch per 100 feet for 100 feet; 1 inch per 100 feet for 100 feet; 2 inches per 100 feet for 100 feet, and 4 inches per 100 feet for the rest of the terrace. The slope of the field (about 5 per cent) is fairly uniform over the part of the field where these terraces are located.

While the records cover a period of only one year, they are beginning to yield some interesting information. There have been a number of small runoffs from the terrace with 4-foot interval when there was no runoff from the other two terraces. This result might be partly explained by the fact that there is one small alkali spot in this area.

During the year there have been nine weeks when there was sufficient rainfall to cause runoff from one or more of the terraces. From June 9 to November 14 there was no runoff whatever from two of the terraces and only a small amount from the other one. During this period there was a total rainfall of 13.77 inches, and of this there were three rains of more than 1.5 inches. This is conclusive evidence that the soil and crop condition is the controlling factor in determining the amount of runoff.

The percentage of runoff was consistently higher for the terrace with the 2-foot vertical interval than for either of the others, but in two cases the runoff was less from the terrace with the 3-foot interval than from that with the 4-foot interval. However, these results agree fairly well with the general runoff law that the longer the slope the less will be the runoff from a given area.

The amount of solid material carried has been determined from only two different runoff periods, but for these the suspended matter varied from 0.469 per cent for the terrace with the four-foot interval to 0.416 per cent for the terrace with the two-foot interval. In the tests the total salts and nitrates carried were in about the same proportion.

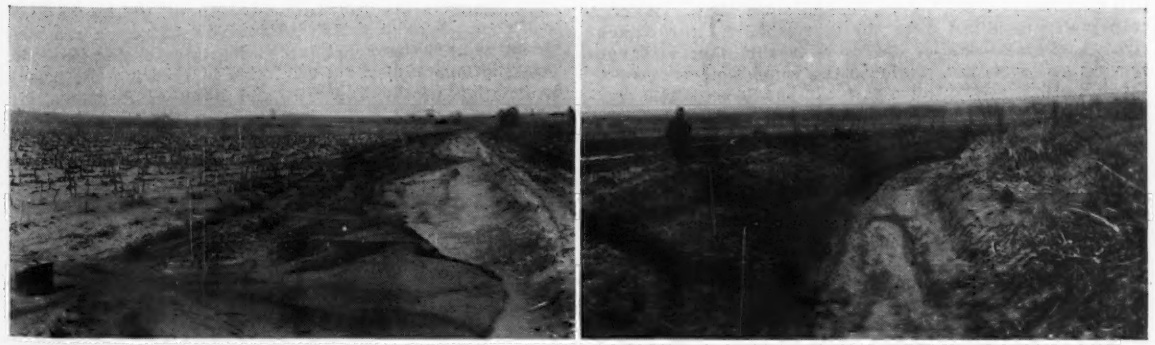
There were some differences noticeable in the field that do not show up from the tabulated data. Above the terrace with the four-foot interval there are a number of small washes into the terrace channel. In no case is there a large amount of this wash, but it is quite noticeable. The material is merely carried down the slope and most of it settles out when the terrace is reached. This wash has not been noticeable above either of the other two terraces.

In general, the results would seen to indicate that, with terraces of the conventional type with a variable grade and well-opened outlets, the total amount of runoff will increase as the vertical interval is lessened, but the amount of soil carried away will be slightly less.

PRECIPITATION AND RUNOFF Project No. 187

Week Ending	Precipitation	Runoff, Cu. Ft.			Runoff, Inches			Percent Runoff		
		Sta. 1	Sta. 2	Sta. 3	Sta. 1	Sta. 2	Sta. 3	Sta. 1	Sta. 2	Sta. 3
4/28/28	2.55	988.95	1192.97	849.96	0.216	0.265	0.357	8.47	11.2	14.0
5/19/28	2.98	3656.74	3318.08	2491.60	0.797	0.797	1.049	26.7	26.7	35.2
6/9/28	2.02	1766.99	1576.49	1148.87	0.308	0.325	0.483	15.2	16.1	23.9
6/23/28	.70	325.30			0.078			11.1		
8/4/28	1.72	83.31			0.011			0.7		
10/27/28	1.71	1.00			0.000			0.0		
11/3/28	2.42	62.75			0.013			0.5		
11/17/28	3.66	6801.84	5442.32	5942.00	1.480	0.824	1.236	40.5	22.5	33.8
12/15/28	2.37	1053.79	791.47	736.97	0.230	0.189	0.304	9.7	8.0	12.8
Total	20.13*	14,710.67	10,021.33	8364.40	3.133	2.480	3.431	15.6	12.0	17.0

Sta. 1 Terrace with 4-foot vertical interval, variable grade, drains 55,100 degree-feet
Sta. 2 Terrace with 3-foot vertical interval, variable grade, drains 50,525 degree-feet
Sta. 3 Terrace with 2-foot vertical interval, variable grade, drains 28,525 degree-feet
* Total rainfall 20.16 inches



(Left) Sediment in the channel of a variable grade terrace with a 5-foot vertical interval. (Right) Eroded channel of a terrace with a 4-foot vertical interval and a grade of 6 inches per 100 feet

Control of Erosion in Oklahoma[1]

By G. E. Martin[2]

EXTENSION efforts at soil erosion control in Oklahoma date back about nine years. Some work had been done before then. It has been my pleasure to visit one field in the state on which the terraces, now seventeen years old, are well maintained and are highly prized as an important factor in the productiveness of the land. The early efforts, especially among our own field forces, were practically all schemes to promote the work. Plans for saving the soil had a distinct appeal to extension men and soon gained favor among the field forces. The early work of C. E. Ramser, of the U. S. Department of Agriculture, helped to stabilize the efforts in Oklahoma, although much had to be learned by experience.

Our earliest efforts attempted to popularize erosion control methods through the demonstration plan. As I understand it, the procedure was to secure the cooperation of a farmer, of course one concerned about his soil losses, and induce him to invest in the lumber and materials necessary to build a wooden V drag. Then on the appointed day the county agricultural agent and the agricultural engineering extension specialist, one or both, would appear upon the scene. The 18-foot, 2x12-inch plank would be cut to the required dimensions with proper angles and nailed together with hitch holds and braces placed to form the drag. Since time was an essential element of the demonstration, this part of the proceeding was breezed through, with as much an appearance of ease as was possible. Running the line was accomplished on a dog trot and then the serious work of dirt moving began. The end of the day would see a partly built terrace and possibly a few more lines run. The first terrace might or might not get further attention and the succeeding terraces would undoubtedly be built to the farmer's own specifications.

In those days our standard dimensions for a terrace did not exceed a width 20 feet on the base and 18 inches in height. Too often terraces were made only 16 feet wide or less and 12 inches high.

Because the early efforts had necessarily to be of a personal service nature they added to the problems of the work. County agents in the southern part of the state were and still are deluged with requests for terrace lines and other personal service work. Gradually we are working our way out of the difficulties. Terracing has not been so completely sold in the northern part of the state. The broadcasted grain has to a great extent prevented the formation of innumerable gullies so prevalent where the row crop system of farming obtains. Also, the strategic placing of straw stacks has strengthened the northern man's belief that his land does not need terracing. Results from well-placed demonstrations and the coming of the combine are helping to change conditions. Lowered crop yields resulting from sheet erosion and the demonstrated effectiveness of terraces in retaining and conserving soil moisture, while at the same time preventing sheet erosion, account for part of the chang. The combine leaves no straw stacks, and is a difficult machine with which to negotiate even small ditches. The spread of cotton as a profitable source of income in the boll weevil free areas of the north and west, also accounts in part for the advance made in erosion control in the northern part of the state. The question of combines riding the ridges has been answered with large, generous, well-built terraces.

Profiting by experience in the southern half, we are attempting to maintain the work in the northern part of the state on an educational basis. Farmers are encouraged in the ownership and taught in the use of the farm level and rod, to the end that they will become independent practitioners of terracing. The same thing is being done in the southern part where the overwhelming demand points to the necessity of the individual caring for his own holdings. Our standard dimensions for terraces now provide for 25 feet of width on the base, and a height of 2 feet on normal slopes. Up to 5 per cent is considered a normal slope. On slopes of 3 per cent or less we now have no hesitancy in advocating a base width of 35 feet or more, with a full 2-foot height. In the almost complete absence of scientific data regarding soil movement and terrace action under varying conditions of soil types, topography and rainfall, we doubt the wisdom of any attempt to lay down hard and fast rules for terracing for any and all parts of the country.

At schools of instruction both for adults and for juniors, we are careful to state that the instructions given in the classroom and in the field are all set down in black and white as nearly as may be, in the circular left in their hands for future reference. The training of 4-H club boys in terracing has had good results in Oklahoma. The young man once trained is sold to future efforts if the need arises. Also the well-trained club boy is the county agent's safety outlet when approached by chronic line running requesters.

Gradually the public consciousness is being awakened to the importance of erosion control, and help in various forms is being made available. Chambers of commerce often provide levels and rods. County commissioners may permit the use of road working machinery free or at slight cost. Such help is often desirable, but should be carefully considered by the extension worker. He usually is the only educational agency available in the county. The promiscuous placing of farm levels and rods in farmers hands by chambers of commerce or similar groups, does not relieve the extension agent of responsibility for the safe operation of such farm levels. Where the levels are always under the control of the county agent, they may be made of immense benefit to the county provided the agent can devote time to properly train the individuals using them.

A factor of importance in plans for erosion control, and one which so far has not been touched upon in this paper, is the tenantry situation in so far as it reflects absentee landlordism. Some of our counties show from fifty to seventy per cent of tenantry. To reach non-resident landowners with extension teaching it not always easy. Individual bankers are generally sympathetic to the work as it affects others in their communities, but often are nonreceptive to the personal application of extension methods. Texas is outstanding among states in securing the hearty cooperation of the Federal Land Bank of Houston. No doubt the control in this instance is with the state extension service, where it rightfully belongs.

The establishment by the U. S. Department of Agriculture of a federal research investigation of terraces and soil erosion in the middle of our state, where it is easily accessible to all interested, will no doubt be of considerable benefit to the work of the extension service as well as to the state as a whole.

In conclusion, I would say that the chief factor in the success of extension efforts for erosion control is quality of work. Terraces that fail hurt the surrounding country, and incidentally the agency responsible, far more than they hurt the owner.

---

[1]Paper presented at a joint meeting of the Southern and Southwest Sections of the American Society of Agricultural Engineers, at Houston, Texas, February, 1929.

[2]Agricultural engineering extension specialist, Oklahoma A. & M. College. Assoc. Mem. A.S.A.E.

Experiments on the Artificial Curing of Hay

By C. S. Nadler[1] and C. L. Osterberger[2]

LOUISIANA can possibly grow as much hay material as any other section of the country, but due to the high humidity, fogs, and rainfall during the harvest months, we are able to cure only a small percentage of the growth. There are records of many hay crops in which every cutting was ruined. Because of this situation a study of possibilities of artificially curing hay was established as an experiment station project.

The preliminary work included gathering data on existing methods of handling this and other drying problems, studying the behavior of hay under natural and artificial drying conditions, and making calculations in order to reach conclusions as to the possibilities of the different known and suggested methods.

We found that the fibrous material in hay had a very low heat conductivity. This, in our opinion, precluded any method but that of circulating dry or hot gas through it.

The next step was to determine the capacity of dry air or gases to carry moisture. Fig. 1 shows the weight of saturated water vapor in one kilogram (2.2 pounds) of dry air at different temperatures. An examination of this curve shows that in order to use air or gases as a medium for curing, either very large volumes or high temperatures must be used.

Combustion engineers have for many years standardized the burning of ordinary fuels, such as coal, oil, gas, etc., obtaining high thermal efficiency and smokeless combustion. The products of combustion are all incondensable under atmospheric pressure at temperatures above 212 degrees (Fahrenheit), and appear to be the ideal drying medium. The specific heat of the gases of combustion is relatively low.

From the above facts it was concluded that, if we could keep the hay in suspension and circulate through it sufficient gases of combustion of ordinary fuels, keeping the whole system at a temperature above 212 degrees, and without injury to the hay, this material could be dried.

The next question was whether or not sufficient heat could be generated per dollar by the combustion of fuel to prove economical.

Tests show that one pound of coal produces approximately 14,000 B.t.u., while one pound of oil produces approximately 19,000 B.t.u. To change one pound of water at 80 degrees to steam at 212 degrees requires approximately 1100 B.t.u.

By referring to Fig. 2 it is found that to evaporate the water in hay containing 74 per cent moisture in order to obtain one ton of hay at 12 per cent moisture, requires the evaporation of 5050 pounds of water, or 5050x 1100=5,555,000 B.t.u., and at 100 per cent thermal efficiency, approximately 398 pounds of coal, or approximately 43 gallons of oil.

At the prevailing prices of oil and coal it was figured that, if we could obtain any degree of efficiency in the transference of the heat from the fuel to the wet hay and in the evaporation of the moisture therein, our fuel cost would be within reasonable limits.

In order that the drier be successful, however, it would also have to meet the following other requirements:

1. Low initial cost
2. Simple operation and control
3. Low power consumption
4. Simple design and low maintenance cost
5. Provide hay having food value, color, aroma and palatability
6. Reduce the moisture content to a predetermined amount low enough for storage
7. Have capacity sufficient to take care of average acreage, and to keep labor, power and overhead charges within economic limits.

Several different cycles that were suggested were tested experimentally. Our discussion from now on will be on the one shown in Fig. 3. This drier, we believe, fulfills the above conditions more nearly than any other that we were able to devise.

With practically every preliminary test we experienced great difficulty in the conveying of long hays such as alfalfa and soybeans, and with the drying of stalks hav-

[1]Sugar engineering specialist, Louisiana Agricultural Experiment Station.

[2]Farm mechanics specialist, Louisiana Agricultural Experiment Station. Assoc. Mem. A.S.A.E.

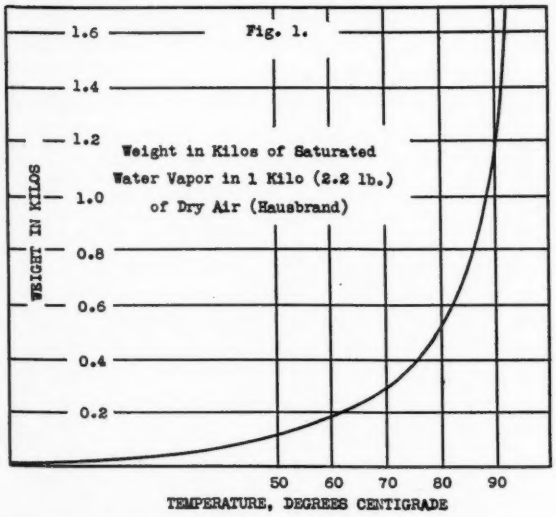


Fig. 1. This curve shows the weight of saturated water vapor in one kilogram of dry air at different temperatures

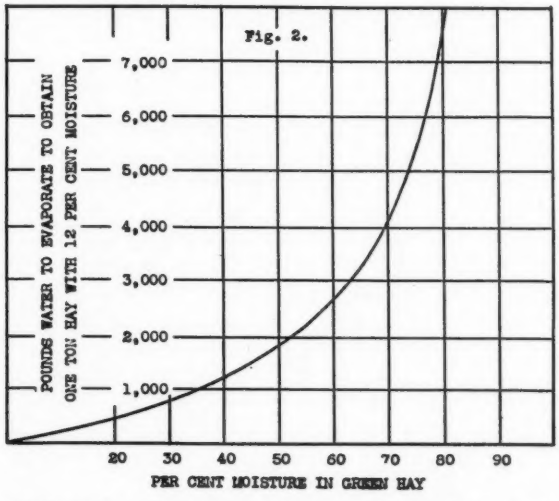


Fig. 2. This curve shows the amounts of water that must be evaporated from green material having varying degrees of moisture content to obtain hay having but 12 per cent moisture

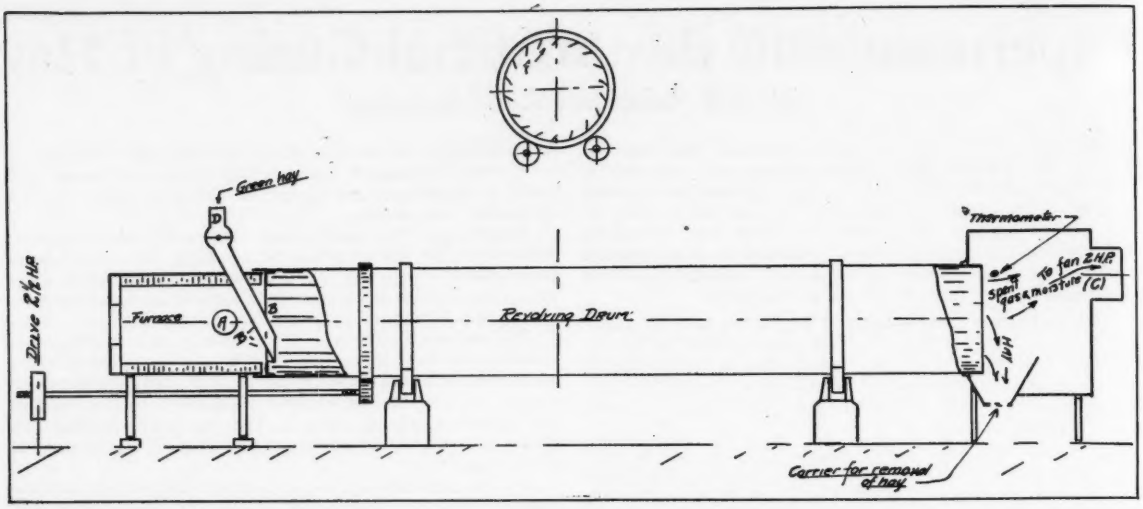


Fig. 3. Side view of the experimental hay drier developed by authors. (Top) Sectional view of the drum of this drier

ing large diameters and thick bark, such as soybeans. From all the information that could be gathered, there seemed to be no particular objection to cutting this material in short lengths except that it was harder to bale. Short lengths simplify the drying problem.

We experienced quite a little difficulty in attempting to cut up the green material, due to the fact that in most cases it would ball or gum up in the various types of commercial mills. By reducing the speed of the feed rolls on an ensilage cutter it was found possible to chop the hay to any degree of fineness desired.

A method of breaking up the large stems of soybeans by passing them through rollers (Fig. 4) was developed. This device consisted of three grooved cast iron rolls in housings and geared so that the back roll would run faster than the other two. A deflector or turn plate was placed between the two bottom rolls and scrapers provided to remove any material tending to collect on the rolls. In every case we had more or less difficulty in conveying the long stringy material, either green or dry, with our equipment.

We also tried to run hay through this mill and found that we could reduce the moisture to as low as 50 per cent. in doing this some of the food value was lost, but we have not yet determined the economic value of this. We devoted the remaining time to tests of hay passed through the modified ensilage cutter, and are therefore unable to give any accurate data on the curing of hays in their natural state.

In the drier shown in Fig. 3 we have a furnace of conventional design to efficiently burn fuel oil without smoke. In most of our tests distillate was used because of the ease in regulating the burning of this fuel. The openings (A) are used to dilute the hot gas from the furnace either with air, or with some of the gases from C. The hot gases enter the drier at B. The fire and amount of dilution was controlled manually to maintain the temperature at the head of the drier approximately constant. A thermostat could be used. Hot gases and the evaporated moisture are drawn through the drier by a fan. A stack could also be used. Hay enters at D and as the drier revolves it is picked up by fingers F and dropped through the path of the gases.

The velocity of the gases that would carry or float the dry hay forward rapidly and that would have very little of this effect on the green or heavy material was found experimentally and the speed of the fan was so regulated as to maintain this velocity.

It was believed that with high gas temperatures, as long as the material contained relatively high percentages of moisture the evaporation would be fast enough to prevent the temperature of the hay from going very mu over 212 degrees, and as the material approached dryness the faster its temperature would approach that of the gas.

Tests showed that by keeping the temperature at the entrance of the drier constant, the temperature at the exist depended upon the amount of moisture fed into the drier with the hay. It was also found that the moisture in the hay at the exit of the drier varied with the temperature at the exit. By experiments we then determined the exit temperature that would correspond to hay having about 11 per cent moisture, and by placing a thermometer here with an indicator at the cutter, so that the temperature could be read by the man feeding the hay, it was found that he could control the ultimate moisture of the

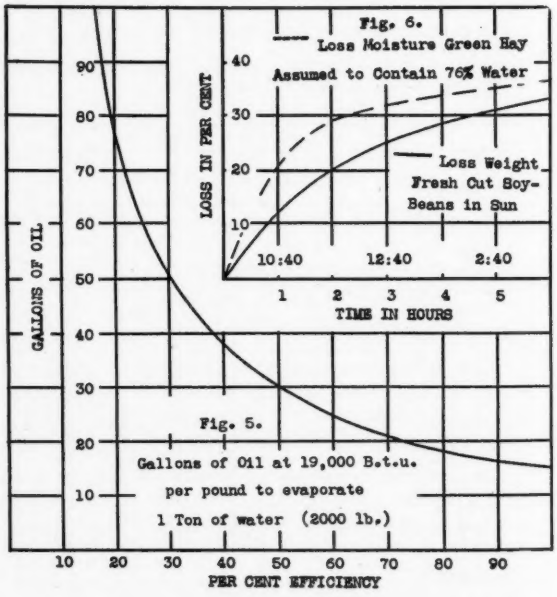


Fig. 5. This curve shows the amount of oil required to evaporate one ton of water at varying efficiencies. Fig. 6. These curves show the percentage loss of moisture from soybeans and green hay during the drying process

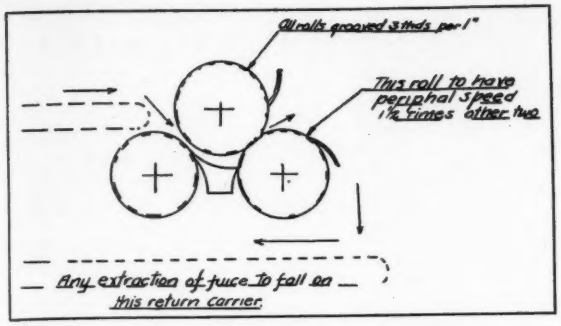

All rolls grooved 3 teeth per 1"
This roll to have peripheal speed 1½ times other two
Any extraction of juice to fall on this return carrier

Fig. 4. Device for breaking up soybean stalks

hay to within close limits by varying the amount of hay fed to the drier.

No attempt was made to insulate the drier, or to return the gases from C to A. It is thought that in this way the thermal efficiency can be increased considerably. Tests showed an increase in evaporation capacity and in thermal efficiency from time to time until a maximum of 966 pounds of water per hour with an efficiency of 56 per cent was reached.

Referring to Figs. 2 and 5 we see that, with an efficiency of 50 per cent, it would take 84.5 gallons of oil to dry enough green hay containing 74 per cent moisture, to make a ton of hay dried to 12 per cent moisture. Assuming a price on oil of 2½ cents per gallon this would cost $2.12 for fuel per ton of 12 per cent-moisture hay.

We ran several experiments to determine the percentage of loss of moisture in freshly cut soybeans dried naturally, and Fig. 6 shows these losses. We used the data for green hay from the U.S.D.A. Bulletin No. 353. By referring to this figure we see that if soybeans are cut after the dew is off and gathered 4½ hours later, the hay will contain approximately 66 per cent moisture. Fig. 5 shows it would take 54.1 gallons of oil at a cost of $1.35 to produce from this material a ton of dry hay.

A six-foot drum has four times the cross-sectional area of a three-foot drum and we can figure no reason why it should not have four times the capacity of our three-foot drier. It is thought, however, that some of the physical

TABLE I. Capacity and Thermal Efficiency of the Louisiana Experimental Hay Drier

No.	Date	Material	Moisture, per cent Initial	Final	7 lb. to gal. gal. fuel per hr.	Lb. water evap. per hr.	Thermal effic.
1	May 11	Oat straw			10.8	587	49.0
2	May 17	Oat straw			10.6	588	48.0
3	May 24	Alfalfa	67.0	12.5	12.0	457	38.0
4	May 25	Mixed alfalfa & soybeans	48.0		7.5	411	46.0
5	Aug.11	Soybeans	72.0			703	
6	Aug.13	Alfalfa & grass	73.0	13.0	11.0	683	52.0
7	Aug.15	"	74.5	8.0	15.0	563	38.0
8	Aug.15	Alfalfa in rain	78.0	12.2		500	
9.	Aug.15	Alfalfa & grass	78.0	13.0	10.0	600	50.0
10	Aug.16	Soybeans	75.0	11.1	10.0	706	59.7
11	Aug.22	Soybeans	76.0	14.0	10.2	608	50.0
12	Sept.14	Soybeans	66.0	11.0	14.1	966	56.0
13	Sept.15 " 24	Soybeans	65.6	11.9	13.7	924	56.0

Tests 1 to 4, inclusive, were made with a temporary furnace.

Tests 5 to 12, inclusive, were made with initial temperatures of 1000 to 1200 degrees.

Tests 12 to 13, inclusive, were made with initial temperatures of 1800 to 1600 degrees.

conditions in a 6-foot drier will be different from those in our 3-foot drier. We have intentionally omitted the experimental data on velocities and temperatures until we can establish their relation to the size and length of drums.

Without attempting to analyze the power cost, except to call attention to the comparatively small horsepower required to operate the experimental machine, and to the fact that it should not take over two men to operate, it is thought that a machine of such size as is capable of producing one ton of dry hay per hour could be economically used.

The color of the hay coming from the drier is about the same as the raw material. The aroma was excellent, and stock readily ate the artificially cured hay.

No experiments have been run yet on the relative value of artificially cured as compared to naturally cured hay, except that the few chemical analyses made showed a higher food value in the artificially cured product. This may be attributed to the fact that all of the leaves are retained in the artificial process. Analyses show that the largest percentage of food value is contained in the leaves. From observation we are confident that a large percentage of the leaves were lost in natural curing and handling the hay tested.

Rural Electric Development in the South[1]

By L. W. Gray[2]

THE term "rural electrification" is capable of rather broad interpretation, which varies to some extent with the section of the country and the problems encountered in its development. The utility beginning a rural electification extension program is governed in its policy largely by local conditions.

Rural electrification was, at one time, largely an experiment, but experience has shown that it can be made to pay its way as it goes, and most utilities are now approaching it upon this basis. Just what basis a rural electrical distribution system is to be built upon, as has been said, is determined by the policy of the utility and the local conditions. In determining the interests that can best be served, consideration is given to the small rural communities and hamlets, and in some instances to the larger rural towns, to the farms along the route and to farm and rural residents.

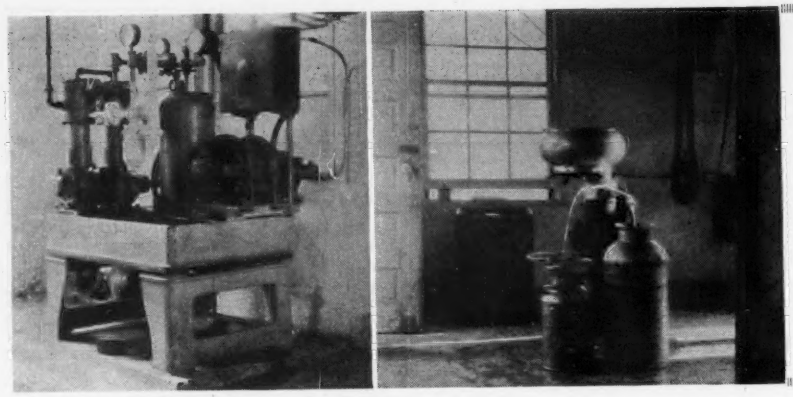
The term "rural electrification" covers all these classes of rural electrical distribution, and some of the utilities are building their rural systems upon one or all these classes of rural business. This results in rural lines with a great diversity of characteristics. Some utilities confine their rural electrification activities to the small communities and farms. Even though the larger rural towns are served on similar rates they are not included in their rural system. Some rural systems are almost entirely built up of farm loads and many of them are proving to be profitable.

A successful rural line may be defined as one that develops sufficient revenue to justify its construction and offers electrical energy to the customers on a rate that will warrant its use. From this definition it seems that rural electric development is largely based upon two factors, revenue and engineering.

A two-part rate has been designed that, in many instances, most effectively meets the situation. It is made

[1]Paper presented at a joint meeting of the Southern and Southwest Sections of the American Society of Agricultural Engineers at Houston, Texas, February, 1929.

[2]Agricultural engineer, Georgia Power Company. Mem. A.S.A.E.



(Extreme Left) An electric refrigeration unit operating in a farm dairy in Georgia. (Left) An electric motor also turns the cream separator

up of a certain line charge, based upon the number of customers per mile, which in some measure helps to meet the carrying charges against the line. In addition to the line charge, there is an energy charge that scales downward very rapidly to encourage a greater use of electrical energy by rural customers.

In many instances, it is very necessary that the customer be encouraged in the use of electricity to a maximum that can be made to economically serve him. Demonstration and educational methods must often be resorted to in order that its value can be established. The maximum utilization of electricity by farm customers, often makes possible a rural line upon a fair rate that otherwise would be impossible of development. When the value of electricity to the farm customer has been established with him, he is likely to become a user of electrical energy in increasing quantities.

Electricity has to be sold; the idea of its use, its place in the farm home, its place in the farm plan. It is no longer a luxury, as many seem to think, but a necessity in the everyday life of the farmer, and once he gets the idea, it is comparatively easy to sell him additional quantities. The idea of better roads, the automobile, the radio, had to be sold to the farmer. The idea of electricity must also be sold to him.

Engineering on rural lines has become an object of some criticism. The "Electrical World" recently asked the question, "How poor can a rural line be built and still be good enough for electrical distribution?" Cheap construction seems to be the means of some of the utilities for meeting the problems of rural electrification. The construction of the line has been cheapened to meet the emergency of reduced revenues. There is some doubt as to the value of such construction, and it certainly cannot be anticipated that very extensive or lasting systems, productive of good results, can be built upon such a basis.

Rural electric engineering has brought out new ideas in the building of electric lines. Higher poles spaced wider apart and the use of bare wire on the distribution system are provided for by the latest specifications. The determination of the voltage to be used is altogether influenced by the demand and the distance. In single or three-phase, 6600 volts may be said to offer the greatest range of usefulness. This voltage may be safely carried 12 or 15 miles with good results where there is no excessively large power load at the end of the line. When 6600 volts are used the extension range is greatly increased over that of 2300-volt distribution systems.

Proper line voltage and regulation is a vital factor and should be maintained upon rural lines as effectively as upon any other type of electrical distribution lines, if the best service is to be delivered. The value of electrical apparatus can be proven only when standard voltage is delivered. The electric range is practically worthless when operated at low voltage.

The 2300-volt system may be safely operated within certain ranges and limited distances. The length of 2300-volt systems is often too great. The result is distressed apparatus and dissatisfied customers.

For long distances the 11,000-volt, four-wire distribution system is excellent.

The single-phase line, when not overloaded, offers dependable service up to certain limits of individual power requirements. The three-phase lines offer better balanced systems and are necessary when certain large individual power demands are encountered. The utility operating in a small, condensed territory can afford to take more chance on single-phase, low-voltage lines than one operating over an extensive territory.

A rural system cannot be built in a day or a year, and as the network of transmission lines is carried farther into rural territory, the possibilities of rural electrification will become greater.

The agricultural college, as a factor in the rural lines development of a state, depends largely upon the attitude of the utilities operating in the territory. The college is an integral part of all rural and agricultural interests in the state. The foundation of some very large rural electrification systems has been built up with the cooperation of agricultural colleges. Rural electrification research has been taken up by a number of colleges and a great deal of data has been accumulated. In fact, there is now a mass of this data and there is great need for the developing of ways and means for its utilization. The home economics department of the college, if properly equipped, is in position to render valuable assistance in the rural electrification work.

State projects on rural electrification, conducted through the agricultural engineering departments of the colleges, have been effective in studying the conditions and preparing bulletins and reports on problems effecting local conditions of rural electrification. Such subjects as wiring the farmstead for electricity, electric power on the farm, electric appliances and apparatus in the farm home, loading farm line transformers, and community enterprises need to be further analyzed and made available in bulletins that can be easily understood by farmers.

After a line has been established it then becomes important that the load be increased on the line. This brings up the problem of electrical merchandising. Selling the farmer requires a different type of merchandising than that which the utility has been accustomed to and requires slight changes in its organization to meet the conditions. The loading of rural lines; the extension policies of rural lines; and the loading of rural line transformers, all offer serious problems.

A utility about to begin the development of a rural distribution system must first determine upon its policy as to the conditions under which it will extend its lines into rural sections. The decision that rural lines must pay their way as they go, offers the best foundation that any rural system can be built upon and the experience of many has proven that rural electrification can be made to pay its way.

Building Design for Southern Conditions[1]

By L. E. Hazen[2]

I SHALL attempt to bring out a few basic factors of farm building design in the problems now confronting us. The suggestions I am making are not founded on station research. Rather they are conclusions drawn from fields notes taken in an effort to determine the best means of remedying the situation.

Most of our building practice has been codified from experience in more northern situations. We still go back to King's treatise on ventilation and his analysis of lighting problems. Also in proportioning the allotting of space we are guided by precedent established in climates of much colder weather and longer periods of winter. Usually we find the Southern farmer getting along with some little temporary shack or shed, and his desire for new buildings is just as likely to be from the standpoint of convenience and appearance as it is from a sincere desire for shelter. We have dairymen that very rarely stanchion their cows longer than necessary for feeding and milking. We have backyard poultry fanciers producing show chickens in coops which are a combination of close confinement and cracks, and the chickens run at large a considerable portion of the year.

We are also contending with the fact that our buildings are erected on foundations of such a character that long before the wood has commenced to decay the door has sagged, the window frames twisted, and the comb of the roof assumed a crooked outline. There is little thought to basements, and we are as anxious to secure shade as we are protection from the wind. In other words, our climatic conditions are such that, if we can offer protection from severe wind and rain and so locate our buildings that convenience of work and sanitation may accrue, we then have a general working basis for the design of Southern outbuildings.

For these reasons we are turning more and more away from precedents now usually incorporated in our plan books, and our teaching material is gradually eliminating such trite assertions as that there should be two square feet of glass or a given ventilation flue area per animal.

The problem which comes to us is very frequently one of expedience. Here is a farmer with very little capital in a country in which the agricultural complexion is changing very rapidly. (An example might be cited from the invasion of the boll weevil). He is very likely to want the building to be of such a form that he could readily convert it from a machine shed to a cow stable or from a swine shed to a poultry house, and that its construction be such that he may readily add to it as his farm business grows and more funds become available. So we are commencing to study unit type construction, not only in terms of the additive unit, but in the terms of convertible units as well. One example of this is illustrated in the design of the Oklahoma poultry house, a building which can be put up in twenty-foot units and lengthened to meet the needs of any size flock. The same idea is being carried out in the portable swine houses. We are now commencing to build dairy stables with a single line of cows, modifying the details of construction so that the building may be either widened or lengthened without seriously altering the construction already established. The damage wrought by insect pests such as the termite and the dry wood borer is leading to considerable interest in wood preservation and in the study of foundation construction. Since our frost does not penetrate very deep and it is difficult to obtain adequate foundation bearing on most soils at shallow depths, we are now giving considerable thought to footing reinforcement and simple methods of installing this in the forms before the concrete is poured, so the footing may serve as a continuous beam of very slight deflection.

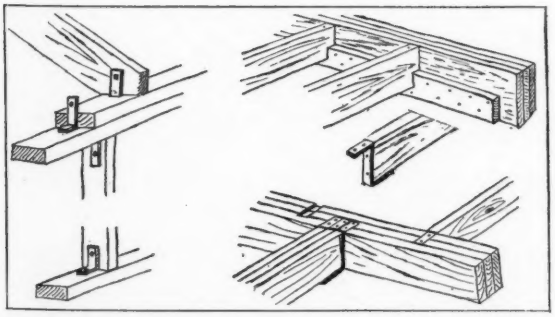
Since many of these buildings are light in construction, the subject of weather protection presents itself with peculiar significance. Our lead, zinc and oil paints suffer severely from the weather, probably due to the extremes of humidity and temperature. A coat of paint which in New York state would remain a clear and delightful white for years becomes a shabby gray in Oklahoma within a few months. The siding, which nailed on in New York state with wire nails would remain in place for a quarter of a century, commences to curl and the nails pull out in Western Oklahoma within a few years. It is no uncommon sight to see nails projecting from a quarter to one-half inch above the surface of the woodwork on buildings covered with lap and novelty siding and erected within the last fifteen years. That leads us to consider the use of screws in the place of nails for the securing of outside trim and it is causing us to give serious thought to stucco or slate covered shingles as a substitue for paint or wooden siding.

Architecturally a building looks better if it is set close to the ground so that flights of steps leading into a dwelling or slopes and terraces approaching the barn are not necessary. Yet the control of vermin by leaving sufficient space between the floors and ground so that these places can be policed and the danger from dry rot and termites eliminated, makes much higher foundations almost imperative. Which means that in so far as architectural treatment is concerned we must approach this matter from a new angle. Our high wind movement is very disastrous to the usual roof coverings now in use. Galvanized iron has the lifting effect of an airplane wing; shingles warp, curl and split; shingle nails rust out; fabric roofing flops and may be torn full of holes, and hard driving rains may penetrate the roof covering with dozens of leaks. This is causing serious attention to types of roofing which are not directly influenced by changes in humidity and are quite secure against ravages of wind and water.

The accompanying illustration shows methods of securing rafters to the plate and studs to the sill because of the splitting which the ordinary type of toe-nailing so frequently entails. We are just commencing to recognize the possibilities of concrete products for roofing materials, and it seems to me that here is a fertile

[1]Paper presented at a joint meeting of the Southern and Southwest Sections of the American Society of Agricultural Enginers at Houston, Texas, February, 1929.

[2]Professor of agricultural engineering, Oklahoma A. & M. College. Mem. A.S.A.E.



Methods of fastening rafters to plates, studs to sills, and joists to girders without toe-nailing

field for investigation and design. We know pretty well how to build walls which will withstand the rigors of a hot, windy climate and offer adequate protection against ordinary extremes of temperature, but our buildings do not become hot or cold so much on account of their walls as on account of their roofs and it is this overhead protection which, structurally speaking, is the weak link in the chain.

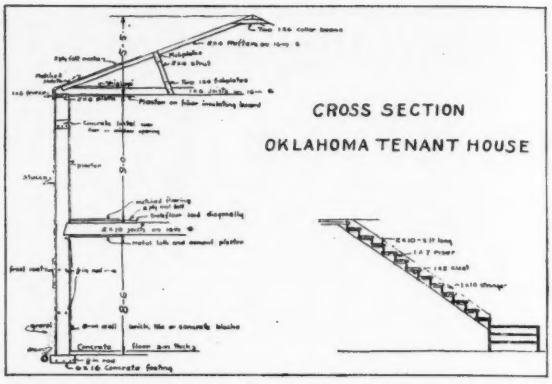
This problem of insulation is being attacked in a number of ways. Some of the most hopeful seem to be in the use of cane fiber products of which Cellotex is an example, and in the use of wood pulp in the form of pressed fiber board, gypsum board and various others. These materials, when nailed to the under side of rafters and floor beams, greatly increase the comfort and useability of buildings designed for human and livestock protection, and their application and preservation are well worthy of station investigation. We are considering these in the design of home refrigeration boxes to replace the expensive cork board, and it is entirely probable that they can be substituted for cork with economy and satisfaction.

We have been attempting to assemble some information on conversion of building use, that is, to obtain a working idea as to what the possibilities are that the building will remain in the service it is designed to meet for a period of, say, twenty years. We found in a count of twenty houses that thirteen of them are being occupied by tenants, yet they were originally designed for home owners. Out of twenty barns, seven of them are now housing tractors and the old stalls now house the automobile, the tractor and the mowing machine. Out of twenty swine houses, nine are serving as poultry houses, two as granaries, while two are standing empty. We cannot claim that these counts are representative of the South as a whole; they merely represent what has happened along a little stretch of road which is easily reached from Stillwater.

These surveys do not consider the relation between soil fertility and the adaptability of the farming type in that locality; neither do they consider the gradual shift of city limits and the absorption of farmsteads for urban residential use. They merely take buildings which were designed and built within the past twenty years and note their structural condition and service as it is today. Probably one of the most amazing changes in farm service is that of the old-fashioned hay barn. We find baled hay piled in one end of the stable. We find straw left in the fields where threshed, and many a horse barn with its loft standing empty. We find only one-third of the silos being used in any way whatsoever, although these silos are well constructed and in an almost perfect state of preservation.

In analyzing our correspondence we find a very decided tendency towards pit and trench silos. Apparently our farmers do not dread using a hoist propelled by a mule any more than they dread operating a cutter propelled by a gas engine. After listening to the arguments pro and con concerning silos, they are pretty likely to conculde that the trench silos are cheaper and good enough. We have repeatedly met the argument that while there may be more waste in a trench silo, it is easier to grow a little extra feed than pay for the additional concrete, tile and steel for pit or tower construction. At any rate, it looks as if modern hoisting mechanisms and modern barn equipment would be the deciding factor in relegating the tower silo into the realms of the obsolete. Of course, it is to be noted that these comments with respect to the silo are based on correspondence from western and southwestern Oklahoma and from our contacts with these sections. Southeastern Oklahoma apparently does not use silos of any kind, although its humid climate would warrant the assumption that the tower silo is the dairyman's favorite.

It is almost universal practice through the sections of the South we are in close touch with to bale nearly all the hay produced, and the old jokes about baling wire for harness making, automobile repair, and fence construction are not so far-fetched as we might at first presume. The floor beams under the early day lofts were too slender to withstand the weight of baled hay which could be readily stored in a small space overhead, so the tendency seems to be toward discarding the second floor, rather than attempting to make its construction heavier.



The farm shop is most noticeable because of its absence. It is rare indeed that we can find a farmstead on which there is a building devoted to the care and use of wood, metal and masonry working tools. We may find some little cubbyhole where pitchforks and hoes are set away, sometimes accompanied by a dull saw and a broken claw hammer, but a serious effort to establish a work bench above which are hung fairly adequate sets of tools, their positions marked by painted silhouettes, are rare despite the fact that the vocational schools are now actively encouraging the construction of such shops and the acquirement of a moderate handicraft skill. Why are not more farm shops constructed and equipped?

Looking forward it seems safe to predict that Southern farms will gradually be reorganized into larger units, and with the increased centralization of control, the demand for shop equipment and facilities sufficient to meet all the minor requirements of building construction and repair will be in order.

I would like to make brief mention of the interest now being shown in fruit and potato storage. I am not offering any suggestions as to the specifications which should be laid down for sweet potato storage, but I have watched with great interest the curing of potatoes in crates or hampers piled one above another for a height of 5 to 7 feet and the air circulated by small electric fans. A series of stoves set in the alleyway around the outside of the building adequately protected the contents of the building against freezing. The only material ventilation provided were the cracks between the vertical boards and the gaps between shingles. The floor was of earth, yet aparently the sweet potatoes were curing in excellent shape and no serious losses have been reported. I would like to know whether the cost of current and fuel would cover the interest charge on a better building provided with modern ventilating equipment and whether in considering the design of such buildings we might be warranted in advocating any better construction than these simple shed-like houses.

In conclusion it would seem safe to say that we must wipe our slate clean and start in rewriting the list of specifications and requirements which shall govern our building design. I do not mean by this entirely discarding the old and substituting entirely the new, but before rewriting the old we should give it careful questioning as to whether or not it is servicable.

New Designs for Southern Farm Buildings[1]

By Deane G. Carter[2]

LIMITATIONS of cost, climate, available materials and local needs present a difficult problem in the design of farm buildings of the South. Hog production is confined largely to the raising of the home meat supply. A majority of our farmers have few cows, few work animals and comparatively small stores of feed. Many farmsteads, particularly the tenant farmsteads, need several small structures that are not found on the larger and more completely equipped farm. The tenant house, whether regarded as a comfortable, practical home for the family, or as an investment on the plantation to house the necessary labor, presents a problem in economical, safe, durable construction.

Much of the general information now available, and most of the published plans of farm buildings are of little or no value under these conditions. At the Arkansas Agricultural Experiment Station, the department of agricultural engineering has given particular attention in the past year to the requirements and design for low cost construction which is in many cases a prime consideration.

The design of the small, low-cost, simplified hog house developed in Nebraska[3] is an example of the type of structure ideally suited to the needs of Southern farms. It is easy to build, and flexible enough to meet varying conditions and demands.

Supplementing this A-type hog house design, the Arkansas station has undertaken the simplification of plans and material lists of other small structures. The self-feeder for hogs has been simplified to one size, one length and two sizes of material, a cutting list and step-by-step method of construction[4]. In a similar way a poultry feeder that meetings the needs of the flock has also been designed for easy construction and a simple, low-cost materials list[5].

The barn plan for Southern conditions can not be the full size, 36-foot dairy, horse, or general-purpose type. It must be designed for two or four head of work stock, and two or more cows. Since much of the feed grown on the farm is for the stock in the barn, hay and feed storage must ordinarily be provided in the same building. Yet the total space requirement is not great, and the universal plan must be flexible as to size, within considerable range. Since the typical plan can not be so large as 36 feet in the crosswise dimension, flexibility must be obtained by some other means than adding or substracting from a typical length. Moreover, it becomes necessary to provide a building adapted for two rows of stock or pens, and to select a standard width in order that framing plans may be prepared.

The design adopted is for a 24x34-foot barn. Framing plans and loft are made similar, but on a reduced scale, as compared with the usual 36-foot barn. Floor plans are designed to utilize the 34-foot dimension for the stall length, mangers, gutters and alleys, providing the same space as would be afforded in a 34-foot barn. The length of the rows is limited to 24 feet.

If the unit system of planning[6] is applied, this small structure affords a cross alley, wall space, and sufficient room for a maximum of 12 cows, 8 horses or mules, or 4 box stalls, pens or feed rooms. By applying the desired units of space, any combination of animals or storage within these limits may be obtained. Since this plan is completely flexible for the smaller establishments, and since any requirement above these maxima can be met by a barn of standard width, it appears that this method may reasonably be applied to the problem of the small Southern barn.

Any study of the small farm and farmstead reveals the definite need for provision for a small poultry flock, outdoor toilet, storage space, wood house and wash house. These facilities are many times entirely lacking. In other cases, the farmstead is encumbered with small, unsightly, ineffective and comparatively costly structures. In connection with some six or eight houses, the department has this year constructed a "utility" house, combining in one more substantial, attractive structure, the functions of two or more separate buildings. This utility house has a ceiled-off, ventilated toilet room in one corner. Next to the toilet room is space for laundry tubs and kettles, fuel or feed, and storage. The remaining portion of the house provides satisfactory space for a small farm flock of 20 to 30 laying hens. The resulting building, made to match the adjacent house in finish, roof and foundation, eliminates the unsightly cheap structures, at a cost that is lower, by contractors' bids, than for equivalent separate buildings.

In the lower cost levels of housing, little attention has been given to structural or human requirements. The two to four-room house, with or without utilities, within a cost range of $700 to $2,000, is rarely considered in the literature of housing planning. There are, however, many cases in which this class of housing is the only possible one. There are apparently at least four levels or stand-

[1]Paper presented at a joint meeting of the Southern and Southwest Sections of the American Society of Agricultural Engineers at Houston, Texas, February, 1929.

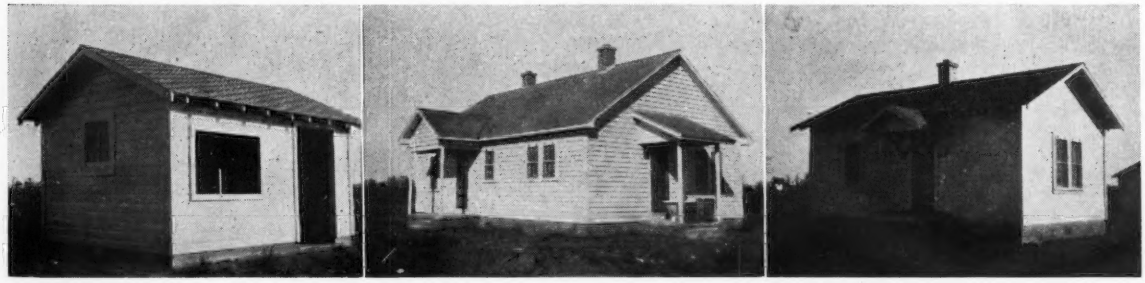
[2]Professor and head of the department of agricultural engineering, University of Arkansas. Mem. A.S.A.E.

[3]AGRICULTURAL ENGINEERING, Vol. 8, No. 10 (October, 1927), pp. 269-272.

[4]AGRICULTURAL ENGINEERING, Vol. 9, No. 5 (May, 1928), pp. 152-153.

[5]AGRICULTURAL ENGINEERING, Vol. 9, No. 11 (November, 1928), p. 342.

[6]AGRICULTURAL ENGINEERING, Vol. 9, No. 9 (September, 1928), pp. 271-273.



(Left) A utility and storage house. (Middle) A four-room foreman's house. (Right) A two-room cottage

ards that may be set up, that include some provision for durability, permanence, appearance and comfort.

At this comparatively low level of cost, there is more opportunity to standardize the size, construction and appearance than would be permissible in homes where more individuality could be afforded.

The first level, the two-room cabin, may not be provided with utilities and convenience equipment. While shelves, water supply, sink and electric lights might be included, these items are usually out of the question on account of cost. A code of minimum requirements, however, might well include tile-lined brick flue, fire-resisting roof, solid foundation, plain millwork, substantial framework, insulating paper, and a finished and painted exterior.

A four-room house, the next higher level, may also be square or rectangular in shape, but in general the same construction requirements apply. In the studies conducted, it was found that the four-room house cost but little more than the three-room house.

By enlarging the four-room cottage two feet in one dimension, space can be provided for clothes closets, and a small lavatory and toilet room. If the interior of this house is plastered instead of ceiled, and the floors and trim painted, the plan is suitable for the better class of workers.

The fourth cost level is obtained by enlarging the four-room house six feet in one direction, affording space for a dining alcove, bathroom, clothes closets, and a larger living room. The kitchen is adapted for adequate built-in equipment. The utilities of plumbing, water supply, and lighting are entirely suitable for this house.

The cost range of the buildings discussed, based upon three to ten contracts for each, under Arkansas conditions, is as follows:

Individual hog house	$9.00 to $10.00
Utility house	$125.00 to $175.00
Small barn	(No figures available)
Two-room tenant house	$600.00 to $700.00
Four-room tenant house	$1250.00
Four-room improved tenant house	$1325.00
Four-room modern house	$1650.00
Four-room modern house with plumbing and water supply	$1850.00

There are many other problems involved in the lower cost Southern farm buildings. Fire-safety, materials, resistance to elements, adaptations in the use of materials, and a study of equipment and convenience are necessary to a full solution of the problem.

Some Recent Developments in Rural Electrification[1]

By E. C. Easter[2]

ACTIVITIES in rural electrification in the southeastern states during the last year have been devoted largely to a continuation of the effort to make electric service more generally available to farmers, and to increase the advantages of electricity to existing rural customers through educational and sales work.

According to the results of a rural survey made by the Southeastern Division of the National Electric Light Association there were 20,485 rural customers being served in its territory on January 1, 1928. Complete figures as to the number of additional rural customers served during the year are not yet available. However, the number of rural lines, miles of rural lines and rural customers added during the year by five operating companies of the southeastern section of the country show an increase of 123 per cent in the number of rural lines, 113 per cent in the miles of rural lines and 82 per cent in the number of rural customers served within the one year. The construction of these rural lines means not only better electric service to present customers, but it is also taking electric power closer and making it more generally available to additional rural customers of the future. Requests for electric service by farmers are being made continuously as indicated by the fact that on January 1 of this year in the case of one company, there were 40 rural lines authorized and under construction that involve 144 miles of line to serve 630 rural customers. There were, in addition to these, twenty-seven additional lines under active consideration involving proposed service to approximately 600 customers.

The effort to increase the advantages and value of electricity to rural customers has been through the use in an educational and sales program, of the investigational and experimental data made available within the last few years. This work has been conducted very largely by agricultural engineers employed by the different power companies working in cooperation with the agricultural extension and research workers.

Various methods are used to increase the use of electricity by the different types of farms in the Southeast. In Alabama this work has been underway for several years and the results are indicated in the increased energy consumption by rural customers served by one company for a period of three years. The average consumption, for the first year was 445 kw-hr.; for the second year, 629 kw-hr., and for the third year, 900 kw-hr.

In 1928 the outstanding development in increasing the use of electricity by rural customers was that of dairy refrigeration. During the year thirty dairymen in Alabama installed mechanical refrigerating equipment. The average annual energy consumption from these installations is about 6,000 kw-hr., with an average connected load of about 3 hp. The operation of these machines has been entirely satisfactory to the dairymen, resulting not only in a greater convenience and better refrigeration, but also in a net saving of about $500.00 per year per dairy, comparing the cost of power plus overhead charges of the equipment with the amount formerly spent for ice.

Considerable attention and effort has also been given to the problem of adequately taking care of the refrigerating requirements of the general farmer, who produces small quantities of various perishable products. Studies of this problem were begun by the agricultural engineering department of the Alabama Polytechnic Institute in 1925, including the design of a suitable farm refrigerator box. Within the last year several manufacturing companies have given consideration to this type of box, and at least one company expects to put a complete refrigerating unit on the market within the next few months designed to take care of the farmer's requirements.

Within the last year M. L. Nichols, of the Alabama Polytechnic Institute, has also obtained patent rights on a small steam generator to which electricity may be applied, for sterilization of dairy utensils and for various other uses. While this equipment is yet to be put on the market, it no doubt is a great potential rural load builder.

The developments for the last year indicate very conclusively that the rural load can and will be increased very materially and advantageously to the rural customers. The cooperation of the college agricultural engineering departments and agricultural extension workers in assisting farmers with the problems involved in the correct use of electricity, is contributing greatly to progress in this direction.

---

[1]Paper presented at a joint meeting of the Southern and Southwest Sections of the American Society of Agricultural Engineers at Houston, Texas, February, 1929.

[2]Chief agricultural engineer, Alabama Power Company. Mem. A.S.A.E.

Production of Peanuts with Power Machinery[1]

By W. A. Clegg[2]

A RESULT demonstration in the lowering of the unit cost of production of peanuts through the use of tractor-drawn equipment exclusively was successfully conducted cooperatively at Albany, Georgia, by the Yancey Tractor Company as operators and J. P. Champion as landowner, with the division of agricultural engineering of the Georgia State College of Agriculture, the county agent and assistant county agent supervising the project. The assistant county agent, R. L. Dolvin, gave close supervision to the demonstration, and to him must go more credit than to any one else for the success of the project.

The agricultural extension force had direct supervision of the tract of land handled by tractors altogether, and in addition received detailed accounts of production costs from the tract of land that was cultivated with teams.

This peanut demonstration was conducted for the following five reasons:

1. To utilize a large farm that has been idle since 1918

2. To find out if it was practical to handle every operation in the growing of peanuts with a track-type tractor

3. To get a comparison between the cost of growing peanuts using tractor power and the cost when horse power is used

4. To find a cheaper method of growing and harvesting peanuts

5. To find out the approximate area that can be handled with a tractor

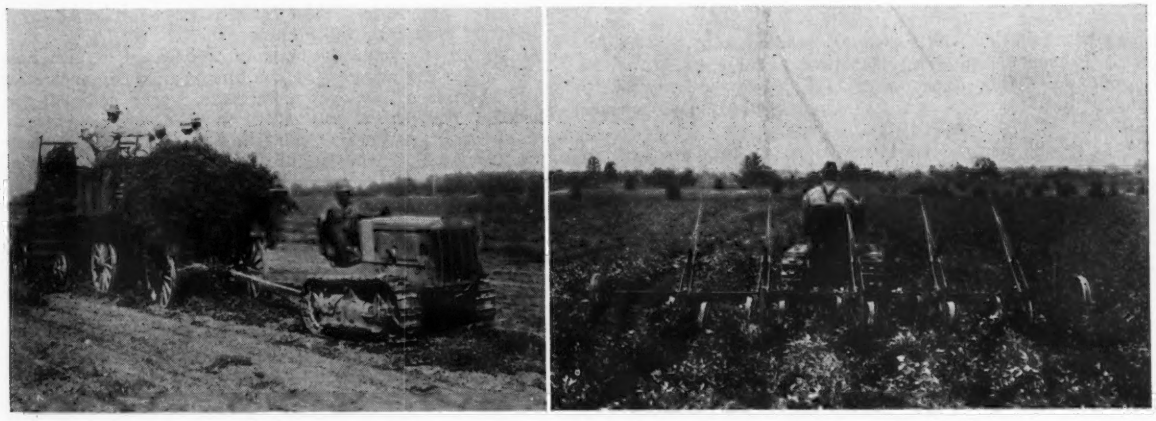
A two-ton, track-type tractor was used to furnish all the power on 168 acres. In addition 300 acres were prepared with tractors and planted and cultivated with mules. The usual one-horse method in vogue over the peanut-growing area was used on the 300-acre tract. The 168-acre tract handled with the tractor was not considered as all the land that could be handled with a two-ton Caterpillar tractor, but it was all the land of the 500-acre tract that was entirely clear of stumps, and due to the fact that it was late in the season before work on this demonstration got under way no time was available for removing stumps. Then, too, the preparation of the seedbed had to be rushed. If work in the field had been started sooner a great deal more seedbed could have been prepared and certainly more than 168 acres of peanuts could have been cultivated with the two-ton tractor.

(For ease in explanation we will call the 168-acre tract handled with the tractor alone the Yancey tract, and the 300 acres handled by a combination of tractors and teams the Frazier tract.)

Because of low prices paid for cotton and a series of poor crop years, a good many farms in south Georgia have been abandoned. The owners of one of these farms wanted to see if peanuts, or some other crop, could be grown on these abandoned farm lands, making them an asset rather than a liability. After consulting their county agent, J. I. Davis, they decided that peanuts might be the best crop to grow. The machinery specialist was called in to aid in the working out of some plan to handle a large acreage with as little labor as possible. The land had been lying idle since about 1918, and good sized pine saplings had grown up all over the field. There were also a few old pine stumps that had not been removed on part of the property. It required $2.10 per acre to completely clear the Yancey tract of the young pine trees and stumps. After the land clearing operations the seedbed was prepared with a heavy-duty disk harrow. The land was harrowed, then cross-harrowed and smoothed with a 15-foot weeder, making a seedbed 7 inches deep. The cost, exclusive of depreciation on equipment, for seedbed preparation, was $1.28 per acre. The planting was done with a five-row planter in 28 inch rows, at a cost of 37 cents per acre. A 15-foot weeder was used just before the peanuts came up. This cultivation was with the rows. The second and third cultivations were diagonally across the field, at low speed and about ten days apart. The fourth cultivation was made with the same tool, five rows at a time, with weeder sections replaced by gang shovels. This was the first row-cultivation and was done about the time the peanuts began to bloom. The fifth and last cultivation was made with a sweep and two shovels between each two rows. The total cost of cultivation exclusive of depreciation on the equipment, was approximately $1.48 an acre. On account of the trash on the land it was necessary to keep a man on the cultivator and this is included in the above cost. It

[1]Paper presented at a joint meeting of the Southern and Southwest Sections of the American Society of Agricultural Engineers, at Houston, Texas, February, 1929.

[2]Associate professor of agricultural engineering, University of Georgia. Assoc. Mem. A.S.A.E.



(Left) Loading peanuts from the windrow with a cylinder-type hay loader on the Yancey tract. (Right) Digging the peanuts with a five-row lister. This machine cut the tap roots and threw the vines out of the ground so they could be raked into windrows for loading. The power was furnished by a Caterpillar tractor

cost 30 cents per acre to get the tall weeds cut with hoes. The total production cost up to harvest time, exclusive of the $2.10 for land clearing and the depreciation of equipment, was $3.43 per acre. On account of the small acreage handled the depreciation and interest charges per acre on the equipment run high. It was the desire of the supervisors of this demonstration to be fair in the analysis of the figures obtained. The charges were figured on the usual basis of 8 per cent interest and 20 per cent depreciation and amount to $2.86 per acre. This added to the $3.43 gives a total production cost of the Yancey tract of $6.29 per acre.

The contract price on the Frazier tract handled with tractors and horses was $8.00 per acre. An extra cultivation was necessary, this costing $1.00 per acre. The farm owner had to have some hoeing done. This cost 39 cents per acre, giving a total production cost to the owner of $9.39 per acre on the Frazier tract as against $6.29 per acre on the Yancey tract.

According to a farm management survey of more than 150 farms in the peanut-producing area of south Georgia, the production cost where peanuts were cultivated as much as these at Albany, was for labor and mule power, $8.01 per acre. These figures indicate that peanuts are produced up to harvest time at $1.72 per acre lower cost with tractor than by the average of south Georgia peanut growers.

On the Yancey tract at harvest five rows were plowed up at a time. A side-delivery rake was used to put the peanuts in windrows. The peanuts were then stacked with pitchforks on poles for curing. The cost per acre for this was $4.855. On the Frazier tract the usual method of harvesting peanuts in south Georgia was followed, that is, the nuts were plowed up with a one-horse plow and picked up and put on poles by hand at a cost of $6.75 per acre. There was no difference in the grade of the nuts put up by these two methods. By using a side-delivery rake and putting peanuts on the curing poles with forks $1.895, or 28 per cent of the cost with the methods now in vogue over the peanut producing area, was saved.

The yield on the Yancey tract was 690 pounds per acre, and 640 pounds per acre on the Frazier tract. These peanuts brought an average of $92.70 per ton. The peanut hay has not all been sold but is bringing $10.00 per ton on the market. The cost of producing, harvesting, threshing peanuts and rent on the 168-acre Yancey tract was $3716.16, or $22.12 per acre. The gross income was $5957.28, or $35.46 per acre. This gives a net profit from the 168 acres of $2241.12, or $13.34 per acre.

On the Frazier tract the production cost, harvesting, marketing and rent on the land was $8319.00, or $27.73 per acre. The gross income was $9987.00, or $33.29 per acre. This gives a net profit of $1668.00, or $5.56 per acre.

The profit from 168 acres in the Yancey tract was $2246.12 and the profit from the 300-acre Frazier tract was $1668.00. On the 168 acres handled with the tractor and harvested with a side-delivery rake $578.12 more profit was made than on the 300 acres cultivated with mules and harvested by the methods used by most farmers in the peanut-producing area of the state.

In the above analysis the advantage shown in favor of the use of tractor equipment is conservative, as we have allowed a very heavy depreciation on the tractor and equipment. In fact, we feel that it is too high, but, as stated before, the supervisor of this project wanted to favor commonly used methods in the analysis of the figures. The two-ton tractor could have easily cared for 250 to 300 acres of peanuts. It was used only 621.5 hours in all the operations of growing the crop of peanuts. This is only 3.7 tractor-hours per acre. At this same rate, to care for 300 acres would require 111 ten-hour days of tractor work. It is not unreasonable to expect to be able to operate a tractor that many days in peanut culture in the Coastal Plains section where one can get into the fields soon after rains.

This was the first demonstration of its kind, and the men in charge had considerable trouble at times with the tools available. Some time was lost and additional expense was incurrred due to the fact that the whole scheme was new. The same crew could grow peanuts with even less expense another year, for the experience gained would enable the men in charge to go ahead without some of the costly experiments that necessarily had to be gone through in the first year's operation.

What is to be learned from this result demonstration in the growing of peanuts? We have concluded that large areas of idle land in the Coastal Plains section of the state can be profitably utilized in peanut production. The figures also indicate that peanuts can be successfully grown utilizing the track-type tractor for every power operation. On this demonstration some rather knotty problems were found, but no more than will be found in developing any new method of handling a crop. Some difficulty was experienced in getting the right implements, but this was to be expected, as this was a new method of peanut culture. No trouble was experienced in crushing the vines where the tractor was run diagonally across the field in the process of weeding. We feel that the track-type tractor can be used, not only in the cultivation of peanuts but also for some other row crops.

Data from this experiment indicate that more money can be made by tractor cultivation than by the usual methods practiced on peanuts plantations. An analysis of the man labor shows that 103.37 days of man labor, or 0.615 days per acre, was required up to harvest time on the 168 acres. According to Bulletin No. 273, Georgia State College of Agriculture, it requires 2.75 days man labor per acre to get a crop of peanuts ready to harvest. Thus the methods used in the demonstration at Albany show a saving in man labor of 2.035 days per acre up to harvest time over methods now used in the peanut belt. The peanuts on the Yancey tract received more cultivation than is customarily given a crop of peanuts. With the improved harvesting methods the man labor is still reduced, making the margin of profit larger.

The demonstration proves beyond the shadow of a doubt that with more efficient use of man labor and the use of harvesting machinery, peanuts can be produced at a lower cost than they are being produced at present. On the Yancey tract a side-delivery rake was used to windrow the peanuts, and the harvesting cost $4.85 per acre, while on the Frazier tract the old method was used and the digging and stacking cost $6.75 per acre. Analysis shows that the real difference in the two propositions was that power and machinery replaced the costly hand labor, doubling the profits per acre.

The proper area of peanuts to be handled by a tractor would of course depend on the power of the tractor. The analysis of the project at Albany shows that 250 acres is not too large an area to be handled by a tractor of twenty drawbar horsepower.

The Yancey Tractor Company has leased a farm near Albany for the purpose of continuing this demonstration and experimentation over a period of years and will prepare the seedbed and cultivate a hundred acres of peanuts, and twenty-five to fifty acres of cotton, with a track-type tractor. In addition to the above-named row crops, 100 acres of small grain will be handled with the same tractor. Their plans also include harvesting the oats and rye with a combine. It is hoped that some data as to the best method of harvesting oats with a combine in this climate will be obtained from the small grain demonstration. Accurate cost accounts will be kept on all the operations.

It is the purpose of the Yancey Tractor Company and the agricultural extension forces of this state not only to work out new methods to cut production costs, but to find a system of rotation and management that will enable a farmer to handle a large acreage per man, producing high yields per acre, and at the same time maintaining the fertility of the soil.

Producing Corn and Soybeans with Mechanical Power[1]

By C. L. Osterberger[2]

THIS paper must be considered more in the nature of a progress report than as setting forth the results of a finished piece of investigation, as it is based upon a rather limited experience. No effort has been made to determine the extent to which power equipment can be utilized in harvesting these two crops, since it was first necessary to determine whether the crops could be produced economically in this manner under our peculiar conditions and with existing equipment. The study shows some interesting results in the use of the all-purpose tractor and equipment in corn and soybean production under conditions somewhat different from usual, as far as soil type, rainfall and drainage are concerned, especially the latter.

The object of the study was to determine the practicability and economy of tractors and tractor equipment in producing corn and soybeans on the alluvial or bottom lands of Louisiana. These lands constitute a large portion of the total cultivable area and are our most fertile and productive soils. In this area we find a varying soil type but the heavy soils prevail. The rainfall over this area averages 60 inches annually. Drainage is difficult because of the low-lying nature of the land and lack of suitable outlets. For this reason fields are a network of open ditches and drains. Laterals range from 50 to 200 feet apart and quarter drains are plowed across each "cut," usually at right angles to the rows, to permit the surface water to reach the ditches.

These ditches, so close together, plus the quarter drains and inadequate drainage constitute our main stumbling blocks to tractor farming. Horses or mules must be kept to plow the ditch banks and quarter drains, or the latter must be put in with a hand shovel, which would be very costly.

The experiments will show, it is hoped, whether it is profitable to produce corn and soybeans on these alluvial lands in standard 3½-foot rows with available equipment. The standard practice throughout this area is to plant on ridges 4 to 6 feet wide.

Approximately 80 acres of old, undrained rice land was set aside for this work. This land had been cultivated or drained for some fifteen or eighteen years, and was covered with indigo weeds and willow trees. It was cleared and a drainage system installed, though the main outlet is poor and inadequate yet. A crop was finally gotten in though little worthwhile data was gathered. Corn and soybeans were the crops last year as well as this year. The field consists of 42 plots or cuts averaging 1.48 acres each, making a total of 60.08 acres in cultivation. Open ditches are located every 150 feet (average) and the average length per cut is 460 feet. It can readily be seen just what a problem it is to utilize tractor equipment in a field so cut up, but this is typical of the area and we wanted to test the equipment under conditions as they exist.

The equipment used was a Farmall tractor with two-row lister, cultivator and planter, and a Fordson-Moline two-row cultivator and a complete Fordson-Kelley two-row outfit.

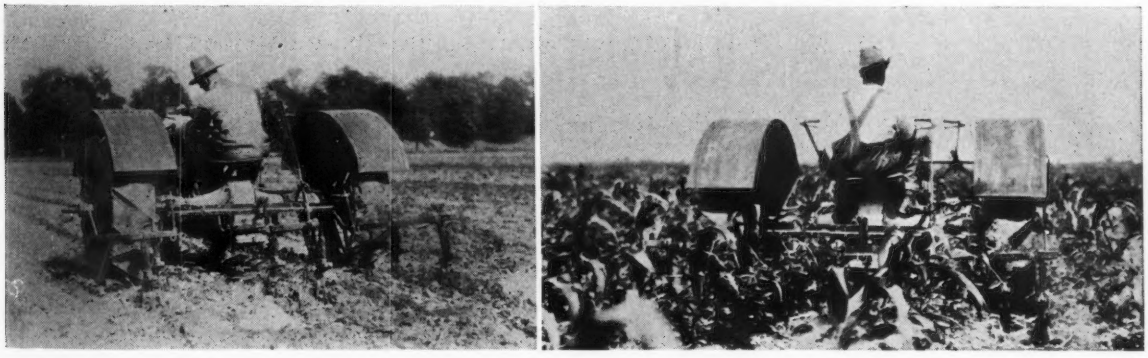
In connection with these studies some related questions arose. Is all of the work that is now being put into corn and soybean production necessary? Can the cost per bushel of corn or ton of hay be lowered by reducing the number of operations? One year's work points toward possibilities, especially with soybeans. For example, two cuts of corn and soybeans planted in 3½-foot rows were disked down and the rows reversed with a two-row tractor lister after the beans had well matured. Nothing was done to these plots except to provide drainage during the winter. Next spring the ground was covered with beans. When they were about 18 inches high they were cultivated (middles only) with the tractor cultivator, three rows at one trip. The larger weeds on the ridge were pulled by hand. No other work was done on this plot and when the beans were harvested for hay a yield of 1.19 tons of fairly good hay per acre was obtained.

Charges per acre against the crop were as follows: 12.35 man-hours and 2.275 tractor-hours, or $2.222 for labor and $1.994 for power. This makes a total cost for labor and power of $4.22 per acre, or $3.55 per ton of hay. The hay was off on July 5 and the land ready for another crop.

Another plot was plowed flat, disked well and planted flat to soybeans on 3½-foot rows in July. They were given one cultivation and when harvested the middle of September the yield was found to be 1.67 tons per acre. Charges per acre were as follows: 7.69 man-hours, 3.86 tractor-hours and 0.87 team-hours, or $1.44 for labor and $3.04

[1]Paper presented at a joint meeting of the Southern and Southwest Sections of the American Society of Agricultural Engineers at Houston, Texas, February, 1929.

[2]Agricultural engineer, Louisiana State University. Assoc. Mem. A.S.A.E.



(Left) A two-row cultivator in the first cultivation of corn and soybeans. (Right) A later cultivation of the same field. This negro operator handles 60 acres for a wage of $2.00 per day

LABOR AND POWER SUMMARY

Louisiana Experiment Station - 1928 - Tractor and Implements - Corn and Soybeans -40.05 Acres

Operation	Acres	Total hours				Hours per acre				Costs per acre-dollars				Acres Per Hr.	Remarks
		Man	Tractor	Team	Woman	Man	Tractor	Team	Woman	Man	Tractor	Team	Woman		
Disking(fall)	40.05	27.41	27.41			0.685	0.685			0.137	0.514			1.46	Scale (per Hour): Tractor operator, 20 cents; other man, 17.5 cents; team, 16 cents; woman, 10 cents, and tractor, 75 cents
Plowing(flat)	22.52	56.42	56.42			2.500	2.500			0.500	1.880			0.40	
Disking(spring)	22.52	15.85	15.85			0.705	0.705			0.141	0.529			1.42	
Bedding	22.52	28.80	28.80			1.280	1.280			0.256	0.960			0.78	
Reversing rows	17.53	20.00	20.00			1.140	1.140			0.228	1.140			0.88	Not flat plowed
Harrowing	48.62	19.18	19.18			0.393	0.393			0.079	0.294			2.54	Peg tooth - high gear
Planting	40.05	55.40	27.70			1.380	0.690			0.258	0.517			1.46	2 men used
Replanting	8.57	11.62	5.81			1.380	0.690							1.46	
Cultivating	40.05	107.30	107.30			2.680	2.680			0.536	2.010			1.49	Average of 4 cultivations
Thinning	40.05	60.00			368.00	1.500			9.20	0.262			0.92		
Plowing drains	40.05	39.40		39.40		0.870		0.870		0.152		0.139		1.15	
Shovelling drains	40.05	45.40				11.350				1.990					Necessary 5 times
Plowing ditch bank	40.05	46.90		46.90		1.170		1.170		0.205		0.187		0.855	Necessary 1 time
Harvesting	40.05	499.40		108.90		12.470		2.420		2.180		0.387			Average yield: 21.88 bu.
Miscellaneous	40.05	108.80				2.720				0.476					Cost: $0.659 per bu.
Total		1545.00	308.50	109.70	368.00	38.700	7.710	4.800	9.20	6.960	5.780	0.763	0.92		$14.42 per acre for labor and power not including ditch maintenance

for power. Total cost, $4.48 per acre, or $2.65 per ton of hay for labor and power.

The accompanying summary table shows the results of our work with corn. Beans were planted with all corn at the time of planting on 3½-foot rows as follows:

1. Corn hill-dropped, 28-inch spacing; beans drilled continuously.
2. Corn and beans planted on alternate rows; corn hill-dropped every 28 inches, and beans drilled continuously.
3. Corn and beans hill-dropped, alternate hills, same row, corn every 28 inches.

One year's results showed the latter system to be beyond a doubt superior, so far as yield is concerned. This method prevents interference with the development of the corn by the beans, especially during its early stages and an increase of as much as 5 bushels per acre over the other methods of planting was noted. We have not yet found a good tractor planter which will plant corn and beans in this manner, and for this reason most of the field was planted by the first method.

It was found impossible to keep down the growth of weeds and grass on the corn rows where the corn and beans were planted on alternate rows, as the field was badly infested with indigo weeds.

It can be seen from this tabulation that the average yield for all land devoted to corn was 21.88 bushels per acre as compared to the state average of 16 to 18 bushels per acre. The cost for labor and power (including all items of expense on the tractor) was $14.42 per acre, or 65.9 cents per bushel. The total cost of this corn, all items included, would still be under the average cost for Louisiana, which varies between $1.00 and $1.25 per bushel. A survey made in 1925 by the U. S. Department of Agriculture, covering twenty-five farms located in the alluvial area of Louisiana, showed the yield to be 22.18 bushels per acre and the cost to be $1.47 per bushel.

The Louisiana Sugar Experiment Station in 1928, producing corn on 6-foot cane rows, found the labor requirements to be as follows: 83.2 man-hours, 16.9 woman-hours, 43.2 team-hours, 2.49 tractor-hours, making a total expense for labor and power of $26.14. This is more than the average amount of work required per acre of corn, due to the fact that a quantity of dirt cleaned out of the ditches was moved to the center of the cuts and reconditioning of the land was necessary.

In producing the crops in this study it should be mentioned that no commercial fertilizer was used, and all the tractor work was performed by a negro who had previously been a plow hand. This one worker handled the entire field except for planting, thinning corn and harvesting. An additional man was used to shovel dirt out of quarter drains after each cultivation.

Two plots were devoted to a test of the ridge as compared to the flat method of planting of corn and beans. All operations were identical except that one-half was planted on a ridge about 6 inches high in 3½-foot rows, and one-half planted flat. This plot was perhaps the best in the field so far as drainage and physical condition is concerned. The soil was rather sandy, hence by no means representative. For these reasons little significance can be given results. It was found that corn planted on ridges yielded 1.69 bushels per acre more than flat planted. It is believed that for the field generally the yield would have been greatly reduced had the corn not been planted on ridges.

SUMMARY

1. It is believed that the field devoted to this experiment is of such lay-out and soil type that it presents as many disadvantages to tractor farming as possible. Any results proving satisfactory here will certainly be possible throughout the alluvial sections generally.
2. General-purpose tractors will never produce crops on our alluvial lands exclusively, where open ditches and quarter drains exist. These ditches and drains affect seriously the rate of work.
3. It may come to light that rows wider than 3½ feet will be necessary in order to secure enough ridge to get the roots of corn and beans up into aeriated soil, because of lack of drainage which is a limiting factor in crop production on alluvial soils. This will mean a redesigning of existing cultivators and two-row lister outfits.
4. A rigid two-row cultivator with shovels behind the tractor wheels seems to be most satisfactory on the heavier bottom soils.
5. It was possible for one negro to handle the plowing, disking, bedding and cultivating of this 60-acre field. This acreage normally would require three men and six mules as a minimum and four men and eight mules as a maximum where 6-foot rows are used. This is worthy of note because of the increasing cost and scarcity of farm labor.
6. Regardless of whether there is any saving in power, there is apparently a saving in labor of from 50 to 75 per cent when these results are compared with labor requirements throughout the alluvial section.
7. Crops were produced exclusively with the tractor except for plowing ditch banks and quarter drains. Corn was laid by when 3½ to 4 feet high.
8. There still seems to be plenty of room for improvement upon tractor equipment suited to our needs, especially planters and cultivators.

A Study of Farm House Costs[1]

By Deane G. Carter[2]

THE value of farm buildings in Arkansas in 1925 was $120,000,000 according to the census of agriculture for that year. With 222,000 farms, the appraised value of buildings per farm was $540. If the usual value of the house as compared with the other buildings holds true, the house valuation would be approximately $270. This valuation is due in part to the large number of negro homes. The white farmer lives in a house valued, on the average, considerably above this figure. Naturally the appraised value is much less than the replacement cost.

Among the factors involved in farm house planning, however, cost is usually the limiting factor, and of greatest interest to the prospective owner. In part as a study of the factors of farm home planning, the department of agricultural engineering of the Arkansas Agricultural Experiment Station has planned and supervised the erection of thirty-four houses, most of which were erected on farms. The locations are in four widely separated sections of the state. Although there is a variation in the costs due to the type of construction, time of building and local conditions, the number of cases affords results sufficiently reliable to indicate closely the costs likely to obtain in the state.

Houses Studied. The houses studied for cost data include the following:

Number	Description
2	Two-room plain
16	Four-room plain
3[3]	Four-room partly modern
3	Five-room, one-story, modern
3	Six-room, frame or frame and stucco, modern
7	Six or seven-room, brick veneer, modern.

Standards. No construction of the so-called "cheap" type was used in any of the houses. Continous foundations, tile-lined flues, composition or asbestos shingle roof, No. 2 dressed pine framing lumber, B grade or No. 1 grade finish, insulating paper in the walls, and finished interiors characterize practically all of the homes. Four of the first cottages built have wood shingle roofs. In the lowest priced groups, under Arkansas climatic conditions, few houses have storm sheathing. In brief, the standards set up for the plain cottages are as given above. The walls are ceiled or plastered. No basement space is included.

The partly modern, small houses included, in addition to the basic construction requirements, enameled interior wood work, sanded and varnished floors, two clothes closets, plastered walls, space for bathroom, some built-in equipment, and a sink in the kitchen. In two of the three a breakfast alcove was included. Plumbing, lighting and heating are not calculated in the costs, because these features are not usually found in the lower priced groups.

The modern frame houses of five to six rooms included all modern facilities of good grade—warm air heat, oak floors, wall sheathing, composition roof, fireplace and basement. The brick veneer houses included highest grades of workmanship, finish and utilities, asbestos roofing, shower, steam heat and similar features.

Local Prices. In order to afford a comparison with other localities the aproximate prices paid for principal materials and labor are given:

Common labor	25 cents per hour
Carpenter labor	65 to 85 cents per hour
Mason	$1.00 per hour
Plasterers	16 cents per square yard
Painters	70 cents per hour
Cement	65 cents per sack
Gravel	$1.75 per yard
Sand	$3.00 per yard
Brick	$16.00 per thousand
Dimension lumber	$27.50 per 1000 feet
Shiplap	$30.00 per 1000 feet
Siding	$50.00 per 1000 feet
Flooring (Oak)	$75.00 per 1000 feet average
Roofing	$ 6.00 to $14.00 per square

Cost Analysis. The total costs recorded are the complete construction costs to the owner, including extras, but not planting, grading sidewalk, or sewage disposal system. They include contractor's profit or superintendence.

Unit or cubic foot costs are calculated by the usual method. The content is determined by the outside dimensions and the average height. When a basement is included, height is calculated from the basement floor. If there is no basement, the height is from the grade line.

[1]Research Paper No. 128, Journal Series, University of Arkansas. Released for first publication in AGRICULTURAL ENGINEERING. The author wishes to give credit to Harold T. Barr, of the agricultural engineering department of the University of Arkansas, for cooperation in the supervision and analysis of seven houses.

[2]Professor of agricultural engineering, and head of the department, University of Arkansas. Mem. A.S.A.E.

[3]Includes one contracted but delayed in building.

(Left) Two variations of the plain cottages analyzed in this paper. (Right) A two-story frame house designed by the agricultural engineering department of the University of Arkansas

SUMMARY OF FARM HOUSE COST DATA

Type of House	Number of cases	Outside dimension	Net area, sq.ft.	Average height, ft.	Net volume, cu. ft.	Half volume of porches	Calculated volume, cu. ft.	Cost per house dollars	Cost per cu. ft., cents	Remarks
Plain 2 room	2	16 x 28	448	13.5	6048	360	6408	794	12.4	ceiled interior
Plain 4 room	4	24 x 30	576	15.0	8640	1080	9720	1080	11.1	wood shingles, no bath space,
Plain 4 room	6	24 x 30	548	15.0	9720	626	10346	1260	12.2	asphalt roof, bath space,
Plain 4 room	2	24 x 28	672	15.0	10080	1000	11080	1400	12.6	high local costs
Plain 4 room	2	24 x 28	672	15.0	10080	1000	11080	1250	11.3	
Plain 4 room	2	26 x 30	700	15.0	10500	852	11352	1100	9.7	low local costs
	4 room house, one story, plain weighted average								11.6	
Semi-modern 4 room	2	24 x 34	816	15.0	12240	288	12528	1650	13.2	bath space, breakfast alcove, without utilities,
Semi-modern 4 room	1	24 x 30	720	15.0	10800	1000	11800	1175	10.0	no contract. Labor supervised
	4 room semi-modern, good construction, one story, weighted average								12.1	
Modern 5 room	1	33 x 38	1254	23.5	29469	840	30309	4600	15.1	
Modern 5 room	1	26 x 43	1118	21.5	24037	480	24517	4700	19.2	
Modern 5 room	1	28 x 38	1064	21.5	22874	420	23294	4100	17.6	stucco on frame
	5 room one story and basement, weighted average								17.2	
6 room stucco	1	26 x 32	832	29.0	24128	630	24758	6000	24.2	asbestos roof; stucco
6 room frame	1	26 x 34	884	30.5	26964	200	27162	5353	19.7	
6 room frame	1	26 x 47	1222	17.0	20774		20774	4300	20.8	1 story, part basement
	6 room, completely modern, weighted average								21.5	
Residence & administration building combined, asbestos roof, steam heat	3	32 x 36+ 16 x 28	1600	23.5	37600		37600	7367 6425 6249	19.6 17.1 16.6	large rooms
	6 room, one story full basement, steam heat, asbestos roof, weighted average								17.7	
6-7 room brick	1	26 x 36	936	30.5	28548	1064	29612	6850	25.2	steam heat
6-7 room brick	1	27 x 37+ 10 x 16	1159	30.5	35349	432	35781	7873	22.0	steam heat
6-7 room brick		27 x 37+ 11.5 x 16.5	1189	30.5	36264	528	36792	10912	29.8	high local cost steam heat
6-7 room brick		27 x 38+ 10 x 16+ 9 x 15	1026+ 295	30.5	35718	420	36138	7986	22.1	steam heat
	6-7 room, 2 story, completely modern, brick veneer, weighted average								24.3	

Porches and extensions are calculated at one-half the volume. Finished sun rooms or sleeping rooms are counted at full volume. The cubic foot cost can be applied for approximation for similar size and construction in Arkansas and other localities where prevailing prices are similar.

Cubic Foot Costs. The accompanying table gives in detail the calculation for each house or group of houses, with the type, area, volume, cost and cost per cubic foot. The weighted average for each group is the total cost divided by the total volume of all houses in the group.

Cost Per Square Foot. Some approximate estimates are made on the basis of the ground area covered by the house. It will be noted in the table that the heights in each group are fairly constant. For example, the height is calculated as follows: For a one-story house, 24 feet wide with a one-third pitch gable roof, and the floor line 2½ feet above grade:

2 ft. 6 inches grade line to floor
8 ft. ceiling
6-inch ceiling joists
4 ft. average roof height
15 ft. total height

The house with one story and basement ordinarily has 8½-foot ceilings and 7-foot basement, making the usual height 21½ feet. In the two-story house the second story and added floor joists give an average height of 30½ feet.

In any case the cubic foot cost times the height affords an approximate figure for cost per square foot.

Cost of One and Two-Story Houses. An effort was made to determine the relative cost for finished space in one and two-story houses. Ten houses in the group were sufficiently alike in construction that a comparison could be made on this basis. Five pairs of similar construction were used. The total cost was divided by the volume of finished space (ground area times height from floor to ceiling). In two pairings there was no difference between the one and the two-story houses in cost per cubic foot of finished room. In one pair the two-story house cost 8.5 cents per cubic foot more than the volume in the one-story house.

In two pairings the costs were 4.5 cents and 8 cents higher, respectively, in the one-story houses than in the two-story houses of similar character.

CONCLUSIONS

These cost figures are average for Arkansas and may be used in localities where unit prices are similar.

The minimum cost for two to four-room houses of fair construction without basement or utilities is almost 12 cents per cubic foot.

Normally the one-story modern house, with basement, warm air heat, complete utilities, frame construction in the five-room size will cost above 17 cents per cubic foot in Arkansas.

Two-story houses of 6 rooms with characteristics similar to one-story modern types will cost about 21.5 cents per cubic foot.

Twenty-five cents a cubic foot will cover the average cost of the completely modern, two-story, six-room house with asbestos roof, brick veneer and steam heat.

Other factors being equal, the larger the volume, the lower the cost per cubic foot.

One-story houses, with basement, cost less per cubic foot of total volume due to the larger portion of basement space in the total.

There is no significant difference in the cost of the finished space in one and two-story houses, as determined from a limited number of cases.

The cost per square foot of ground area is approximately 15 times the cubic unit cost in the case of plain cottages, 21.5 times the cubic unit cost in the one-story modern house with basement, and 30.5 times the unit cost in the two-story completely modern houses.

Agricultural Engineering Digest

A review of current literature on agricultural engineering by R. W Trullinger, specialist in agricultural engineering, Office of Experiment Stations, U. S. Department of Agriculture. Requests for copies of publications abstracted should be addressed direct to the publisher.

Electricity on the Farm (Oregon Station (Corvallis) Biennial Report 1925-26, p. 39).—In experiments on hay hoisting the results indicated that the most desirable type of hoist is one having two drums, one for the pull-up cable and the other for the pull-back cable. These drums should be geared so that the two cables travel at approximately the same speed. The results further showed that the power hoist will not put the hay into the barn much faster than will a team but that one team and one man can be eliminated from the hay crew.

Investigations in the Relation of Electricty to Agriculture (Oregon Station (Corvallis) Biennial Report 1925-26, pp. 107, 108).—A summary is given of work done by the station on the application of electricity to agriculture as part of the work of the Oregon Committee on the Relation of Electricity to Agriculture. Special attention has been devoted to prune drying and lighting laying houses. Minor projects included studies of electric incubation, green feed chopping, and the like.

Importance of Mixture Ratio in Rating Fuels for Knock, J. M. Campbell, W. G. Lovell, and T. A. Boyd (Industrial and Engineering Chemistry (Washington, D. C.) 20 (1928), No. 10, pp. 1045-1048, figs. 8).—Studies are reported which showed that the tendency of a fuel to knock is very sensitive to changes in mixture ratio. Since the change in tendency to knock with changes in carburetor adjustment varies according to the composition of the fuel, it is necessary to choose some definite ratio mixture for knock-testing work if reproducible results are to be obtained. The use of mixture ratios giving maximum knock for each fuel is suggested as a convenient means for obtaining more consistent results between different laboratories.

The Husker Shredder on Eastern Corn Belt Farms, G. W. Collier, W. R. Humphries, and E. W. McComas (U. S. Department of Agriculture, Farmers' Bulletin 1589 (1928), pp. II+21, figs. 11).—This bulletin is based largely on information obtained cooperatively by the Division of Farm Management and Costs of the Bureau of Agricultural Economics, the Division of Agricultural Engineering of the Bureau of Public Roads, the Animal Husbandry Division of the Bureau of Animal Industry, and the agricultural experiment stations of Ohio, Michigan, Indiana, and Illinois, concerning the experience of farmers who used husker shredders in harvesting their 1927 corn crop.

The shredder has been found to be very effective in destroying the borers in corn fodder. Shredding is most important in districts and on farms where there is a shortage of hay and straw for roughage.

Tractors with a belt rating of 16 to 20 hp. are commonly used in operating four-roll and six-roll husker shredders, and 25 to 30 hp. tractors are used for eight-roll machines. In corn that yields 35 bushels per acre the husking capacity varies from about 125 bushels a day for a two-roll shredder to 500 bushels a day for the 10-roll size.

To operate a husker shredder economically one should shred about 45 acres per season with the two-roll size, 70 acres with the four-roll, 90 acres with a six-roll, 110 acres with an eight-roll, and 135 acres of corn per season with a ten-roll shredder. The stover should be tramped as little as possible in storing. The hood of the blower should be adjusted frequently so that the wet butts of the stalks and the shelled corn will not accumulate in one place.

Combining Unevenly Ripened Wheat, H. E. Murdock and M. L. Wilson (Montana Agricultural College (Bozeman) Extension [Pub.] No. 92 (1928), pp. 15, figs. 16).—Practical information on the subject is presented, it being pointed out that wheat growers on large acreages should use the combine method of harvesting but should use either the windrow method or the header barge method to insure against loss.

Action of Accelerators and Inhibitors upon the Oxidation of Liquid Hydrocarbons, T. E. Laying and M. A. Youker (Industrial and Engineering Chemistry (Washington, D. C.) 20 (1928), No. 10, pp. 1048-1052, figs. 9).—Studies conducted at the University of Illinois are reported in which an apparatus and method were devised for determining the effect of various inhibitors and accelerators of knock upon the slow oxidation of hydrocarbon fuels. Data are given to show the effect of various substances upon the slow oxidation of n-heptane and its normal oxygen derivatives, gasoline, and kerosene. A surprising similarity is shown betweent the action of lead tetraethyl and various compounds of sodium and potassium, and also a difference in the action of lead tetraethyl and these compounds of sodium and potassium upon the oxidation of hydrocarbons, in the gas or liquid phases.

"It appears, then, that for a compound to have properties to be classed as a suitable antiknock, it must be an inhibitor of gas-phase oxidation and an accelerator of liquid-phase oxidation. Compounds which fail to approach lead tetraethyl but which have some effect as antiknocks appear to have their effect only in one of the phases present in the gas engine at the temperatures tested."

Pulverizing Limestone on the Farm, F. D. Jones (Tennessee Station (Knoxville) Circular 23 (1928), pp. 4), figs. 3.—The results of experiments on the grinding of limestone for agricultural use with the small hammer type of pulverizer are briefly presented.

Hard limestone, marble, and dolomite were used in the experiments. Of the three, the least power was required to pulverize marble, followed in order by the hard limestone and the dolomite. Increasing the speed of the machine was found to lower the power consumption. Also, as a general rule, the capacity of the machine increased as the speed increased. It was found, however, that none of the hammer machines should be operated at more than 1,500 r.p.m. The results indicated further that the size of the unpulverized material has little to do with the power consumption. Beating or breaking up the material beyond a certain point does not pay under ordinary circumstances. The cost of pulverizing was found to be a variable figure, changing with every case.

Mechanical Harvesting of Cotton in Northwest Texas, D. L. Jones, W. M. Hurst, and D. Scoates (Texas Station (College Station) Circular 52 (1928), pp. 31, figs. 18).—This circular presents the results of an investigation on the mechanical harvesting of cotton in northwest Texas, made in cooperation with the U. S. D. A. Bureau of Public Roads.

The cost of harvesting and ginning sledded cotton is shown to be approximately $10 per bale less than for picked or snapped cotton, but the prevailing penalty of about $10 per bale for sledded cotton did not justify the little advantage secured by sledding during the 1927 season, since labor was available for harvesting by other methods. Small particles of leaves adhering to the lint and immature or discolored fiber mixed with the good cotton are some of the factors responsible for the difference in grade. Mechanically harvested cotton, whether it is picked or stripped, is not necessarily of a lower grade than hand-picked cotton. Enough evidence was secured to prove that cotton harvested by either of these methods under proper conditions will be of good grade, it having been demonstrated that stripped cotton can not be distinguished from hand-picked cotton when properly handled.

[Conclusions from Work in Agricultural Engineering at the Montana Station], H. E. Murdock et al. (Montana Station (Bozeman) Report 1927, pp. 66-70, figs. 3).—Data are reported from experiments on the cultivation of listed corn, the use of the furrow drill and the combine, and on duty of water in Montana. In work on the measurement of hay in stacks the results showed that the actual cross section of a haystack is greater than that obtained by using the rule provided by state law.

Book Review

"Steel Construction," published by the American Institute of Steel Construction, Inc., is an engineer's and architect's handbook which makes available in one volume the latest and best technical data on the subject. General headings given the material are standard specifications, A. I. S. C. code of standard practice, history of steel and iron, properties of sections, formulae for beam loadings, general mathematical tables, strength of materials, general information, explanation of A. I. S. C. specifications, rolled structural shapes, built-up sections, dimensions, functions, allowable load tables and rivets. The wealth of graphic and tabular data presented in the 400 pages is clarified by line drawings, and indexed for easy finding. This book can be obtained from members of the Institute or from its headquarters at 200 Madison Ave., New York, N. Y., at $1.50 per copy.

AGRICULTURAL ENGINEERING

Established 1920

A journal devoted to the advancement of the theory and practice of engineering as applied to agriculture and of the allied arts and sciences. Published monthly by the American Society of Agricultural Engineers, under the direction of the Publications Committee.

PUBLICATIONS COMMITTEE

J. B. Davidson, Chairman

G. W. Iverson P. S. Rose

F. A. Wirt R. W. Trullinger

The Society is not responsible for the statements and opinions contained in the papers and discussions published in this journal. They represent the views of the individuals to whom they are credited and are not binding on the Society as a whole.

Contributions of interest and value, especially on new developments in the field of agricultural engineering, are invited for publication in this journal. Its columns are open for discussions on all phases of agricultural engineering. Communications on subjects of timely interest to agricultural engineers, or comments on the contents of this journal or the activities of the Society, are also welcome.

Original articles, papers, discussions, and reports may be reprinted from this publication, provided proper credit is given.

RAYMOND OLNEY, Editor

R. A. Palmer, Assistant Editor

The South

THIS issue is devoted largely to the agricultural engineering problems of the South. The American Society of Agricultural Engineers is holding its annual meeting in the South this year to get better acquainted with its agricultural engineering problems.

But the South is a big place. As an agricultural engineer in the Southeast has expressed it, "You are being told that you are coming south, but to us Dallas is distinctly west and not considered typical of the South." If there is (or used to be) a "solid South" politically, there certainly is none agriculturally. The South presents not one but many sets of conditions, each involving somewhat different agricultural engineering problems.

However, generally speaking, from the standpoint of climate and growing season it enjoys a tremendous advantage over the North. It also has some big soil and moisture control problems. In topography, much of it is less adapted to the use of machinery than the plains and prairies of the north central states. It meets low-priced-labor competition from tropical countries. Much social and economic reorganization will be necessary to make possible on a large scale the use of modern production methods. In the older sections particularly there are strong traditions to be overcome.

But as these disadvantages are overcome the South must become increasingly a land of opportunity. That it is not only attracting the attention of the agricultural sciences and of agricultural engineering, but is also making a growing demand for their services, is an encouraging sign.

Farmer Executives

AN ATTEMPT to develop farmers as executives rather than as mechanics may herald a new era in agricultural extension work as a whole. The men who are making this attempt are Claude K. Shedd, specialist in agricultural engineering, and D. C. Wood, specialist in economics, of the University of Missouri. In a project, entitled "Engineered Crop Production," they are placing the emphasis not on how to do certain operations but on how to get them done.

That, in short, is what executive ability is—the ability to get things done and to get them done at the proper time; to see the parts of an enterprise in relation to the whole; to meet and master new situations; to organize and direct the use of land, labor, and capital as a winning team. Men without executive ability who try to manage enterprises are dogs-in-the-manger, incapable of using their resources to good advantage and unwilling to submit them to the direction of others who could.

Farmers need executive ability to enable them to profitably apply the information on agriculture which is developed by research and proclaimed by extension workers. One big reason for common agricultural practice lagging so far behind the scientific knowledge of agriculture, is a lack of executive ability on the part of many farmers. From the standpoint of its complexity no industry warrants executive attention more than agriculture. Furthermore, agriculture is now in competition with industries managed by the best executive ability obtainable. The day of an agriculture prosperous in spite of its inefficiency is past.

To what extent farmers can be developed into executives is another question. Admittedly, the possibilities are limited with the conservative, slow-to-act, ordinary farmer who insists on remaining an ordinary farmer. But apparently there are many farmers who have the ability, the ambition and the progressiveness required to profit by training along executive lines.

If the Missouri project proves this to be true, extension forces may find that they have had the cart before the horse and that more rapid progress can be gained by giving farmers an opportunity to learn how to get work done preliminary to, or along with, attempts to teach him what should be done and how to do it.

The Greatest Engineering Problem

WHAT is the greatest engineering problem of today or of all time? Is it the building of some great canal, bridge, tunnel or skyscraper, or the invention of some intricate machine? If engineering has for its object the benefit of man, the greatest engineering problem—and it is the problem of every engineer—is to understand man and how he can be benefited.

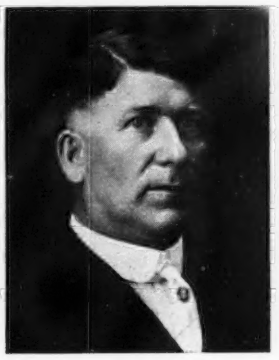
For can there be any logic in measuring, designing and calculating with great exactness on a job unless the reason for doing the job, and its possible value, have been studied just as thoroughly? Surely the question of what should be done and why is just as important and warrants as detailed a study as the exact manner of doing it after the action is decided upon.

And it is just as much engineering work. The rest of the world is too busy to look around for jobs for engineers. The engineer can expect to get no further than anyone else by waiting around for some boss to tell him what to do. It is up to him to study life and determine for himself how he can benefit people. Many ways of serving men through the application of engineering technique have been discovered and are being pursued diligently. But new and greater opportunities are being created continually by changes in the way people live, and on the other hand, there are always engineers looking for jobs or for opportunities to improve their positions. The only thing that can stand in their way is a lack of understanding of life and the opportunities it presents for engineering service.

To the agricultural engineer this implies that he can profitably use a thorough knowledge of principles of economics and sociology and of their particular applications to agriculture. Having this knowledge he can see the problems of agriculture; see wherein engineering can contribute to their solution, cease to bother, in a professional way, about the problems in which he can be of little help; and concentrate on the points where his services may be most valuable. Then his field is cleared for action. He is ready to make certain and profitable use of his technical knowledge and skill.

Who's Who in Agricultural Engineering

W. H. Worthington



I. W. Dickerson

H. B. Roe

F. W. Duffee

W. H. Worthington

Wayne H. Worthington (Mem. A.S.A.E.) is doing special engineering work on combines and attachments for the Gleaner Combine-Harvester Corporation. After receiving bachelor's degrees in both mechanical and electrical engineering from Oklahoma A. and M. College in 1910, he entered foreign service for the J. I. Case Company, Inc., for which he spent three years in South America and one and one-half years in European Russia and Siberia; returned to the United States to work for the Aultman and Taylor Machinery Company of Mansfield, Ohio, as draftsman, designing engineer and experimental engineer; was employed in 1917 by the Electric Wheel Company of Quincy, Illinois, as designing engineer and was soon promoted to the position of chief engineer; returned to the Aultman and Taylor Company in 1919 as chief engineer; was employed by the Advance-Rumely Company when it bought out the Aultman and Taylor line and was soon made chief engineer of the Battle Creek, Michigan, works of the company; was transferred to the headquarters of the organization at LaPorte, Indiana, and put in charge of the engineering departments of all of its works. Early this year he accepted his present position.

I. W. Dickerson

Ira Wilmer Dickerson (Mem. A.S.A.E.) is agricultural engineering editor of "The Farmer," "Prairie Farmer," "Wallace's Farmer," and the "Wisconsin Agriculturist." He received his bachelor's degree in electrical engineering from the University of Illinois in 1909, but almost immediately accepted a teaching position in the department of farm mechanics of that institution and soon became affiliated with this Society. Leaving the university in 1917, he was in charge of the tractor research department of the Hart-Parr Company for several months until in 1918 he found his present work. While at the university he spent his summer months getting valuable experience in various branches of agricultural engineering by doing concrete and building repair work, experting and other work for the International Harvester Company and for the Hart-Parr Company, serving as observer at the Winnipeg Motor Competition and later at the Fremont Tractor Demonstration, and managing the Champaign tractor demonstration (in 1915). He served as secretary of the Society for more than a year and served a term as chairman of its Standards Committee.

H. B. Roe

Harry Burgess Roe (Mem. A.S.A.E.), a past chairman of the Land Reclamation Division of the American Society of Agricultural Engineers, is associate professor of agricultural engineering, University of Minnesota, in charge of instruction in land reclamation and specializing in drainage research. A graduate in engineering at Minnesota, he entered the agricultural engineering field after a decade of work in the railroad engineering field that had brought him into constant contact with the agricultural development of the northwest of the United States and Canada. He became instructor in mathematics in the College of Agriculture at Minnesota in 1908, and a year later, instructor in the newly organized division of agricultural engineering. A tireless booster for agricultural engineering education, he was the father of the professional course established at Minnesota in 1924. He is co-author of a text "Mathematics for Agriculture and Elementary Science" and is the author of several articles on agricultural engineering and of numerous articles and bulletins on drainage. He has served the Society on several committees, was chairman of the drainage committee in 1925-26 and chairman of the Land Reclamation Division the following year.

F. W. Duffee

Floyd W. Duffee (Mem. A.S.A.E.) is associate professor of agricultural engineering at the University of Wisconsin. An agricultural engineering graduate of Ohio State University in 1915, he immediately accepted a position as instructor in agricultural engineering at Connecticut Agricultural College. While there he taught all agricultural engineering subjects and, in addition, field crops and soils, to agricultural short-course students. In September 1918 he went to the University of Wisconsin as instructor in agricultural engineering. The following summer he spent in experting and demonstration work for the Oliver Chilled Plow Works. Since that time he has risen to the rank of associate professor and has been placed in charge of the farm power and machinery work of the department. His principal activity aside from teaching, has been his research on ensilage cutters, since 1921, and the active direction of the Wisconsin rural electric project since it was started in 1924. He is secretary of the Wisconsin Committee on the Relation of Electricity to Agriculture. In the Society he is a member of the Committee on Farm Machinery Instruction and chairman of the Committee on Grain Drying.

A. S. A. E. and Related Activities

A.S.A.E. Officers for 1929-30

THE American Society of Agricultural Engineers recently held its annual election of officers for the year 1929-30, who will take office at the close of the annual meeting of the Society to be held at Dallas, Texas, June 24 to 27, 1929. The successful candidates in the Society's election are as follows: President, W. G. Kaiser, agricultural engineer, assistant manager, cement products bureau, Portland Cement Association; First Vice-President, Arthur Huntington, public relations engineer, Iowa Railway and Light Company; Second Vice-President, F. W. Duffee, associate professor of agricultural engineering, University of Wisconsin; Treasurer, Raymond Olney; Councilor, F. R. Jones, associate professor of agricultural engineering, A. & M. College of Texas. The Nominating Committee consists of O. W. Sjogren, Killefer Manufacturing Company, chairman; R. U. Blasingame, Pennsylvania State College, and F. A. Wirt, J. I. Case Company, Inc.

The Society's Council (board of directors) for the coming year will include, in addition to the president, vice-president, councilor, and treasurer just elected, the following: A. H. Hoffman, research specialist in agricultural engineering, University of California; G. W. Kable, director, National Rural Electric Project; O. B. Zimmerman, engineer, International Harvester Co., and William Boss, chief, division of agricultural engineering, University of Minnesota.

North Central Section Meets at Fargo

RECLAMATION, farm buildings and weed control were the topics of the day when the North Central Section of the American Society of Agricultural Engineers met at Fargo, North Dakota, Saturday, May 4. The meeting was well attended and the program was carried out substantially as scheduled. This was the third meeting of the Section.

Radio station WDAY of North Dakota Agricultural College cooperated with the Section by giving generously of its broadcasting time on Friday evening, May 3, to let the agricultural engineers tell the people of the surrounding country about the application of engineering to agriculture and about the Section meeting.

R. C. Miller, agricultural engineer, North Dakota Agricultural College, introduced to the invisible audience William Boss, president of the American Society of Agricultural Engineers, E. M. Mervine, chairman of the North Central Section of the Society, and H. B. White, secretary of the North Central Section.

President Boss gave a brief history of agriculture, agricultural engineering and the American Society of Agricultural Engineers. He pointed out that the great changes of the past fifty years have not been changes in climate, life processes, or human nature, but rather in the way people live and the kind and amount of work they do. Engineering and other forms of technical progress, he said, were largely responsible for the changes. The continued development of efficiency in agriculture, he concluded, will make possible higher standards of living, shorter working hours and increased attention to the higher things of life. Chairman Mervine talked more specifically along the line of the economics of agricultural prosperity and opportunities for engineering in agriculture. Secretary White announced the program for the following day.

"Reclamation and the Farm Business in the North Mississippi Valley," by H. B. Roe, agricultural engineer, University of Minnesota was the first of the reclamation papers. Mr. Roe stressed the importance of extension and other educational activities as a means of upsetting current erroneous beliefs that all reclamation activities should be suspended for the present, in view of agricultural conditions. Ralph L. Patty, agricultural engineer, South Dakota State College, described the extension work of that institution in tile drainage, and Dalton G. Miller, agricultural engineer, U. S. Department of Agriculture, presented a paper on the increasingly popular subject of "Soil Erosion."

Henry Giese, agricultural engineer, Iowa Agricultural Experiment Station, spoke briefly on helping farmers to build good buildings, and described the development of a standard plan service as a means of making engineering service more widely available at a lower cost.

Chairman Mervine, who is agricultural engineer at Iowa State College, and manager of the experimental farm of the agricultural engineering department at that institution, told of some of the advantages of departmental farms. According to Mr. Mervine the first year of departmental control and operation of its 160-acre tract not only resulted in a profit but gave the department more freedom in demonstration and experimental work, and stimulated increased interest and effectiveness in their work on the part of both the faculty and the students.

"Training in Farm Machinery," a paper by H. H. Sunderlin, agricultural engineer, Caterpillar Tractor Company, covered both of the college and commercial aspects of that subject.

On the weed control section of the program O. A. Stevens, associate professor of botany at North Dakota State College, presented the viewpoint of the botanist; J. K. MacKenzie, assistant superintendent, Experiment Station of Southwestern Saskatchewan (Canada), discussed field burners as a means of control; R. H. Black, agricultural engineer in charge of grain cleaning investigations, U. S. Department of Agriculture, covered the cleaning machinery angle of the problem; and R. C. Dynes, assistant county agent leader of North Dakota, gave the farmer's viewpoint.

At a dinner, the climax to the program, President Boss addressed the group on "The Work of the Agricultural Engineer: Its Scope and Purpose."

Officers elected by the Section for the succeeding year are as follows: Chairman, M. M. Jones, agricultural engineer, University of Missouri; first vice-chairman, R. C. Miller; second vice-chairman, C. S. Whitnah, agricultural engineer, Western Steel Products Company; secretary-treasurer, H. L. Wallace, agricultural engineer, University of Nebraska.

North Atlantic Section Meets at Amherst in October

AMHERST, MASSACHUSETTS, October 17-19, are the place and dates selected for the next meeting of the North Atlantic Section of the American Society of Agricultural Engineers. This section held no technical meeting last year due to its serving as host to the Society at its annual meeting at Washington.

W. C. Harrington, chairman of the Section, has named a program committee and a local arrangements committee to complete preparations for the three-day gathering in the Northeast. The program committee consists of B. B. Robb, chairman, C. I. Gunness, R. T. Wagner, and D. E. Blandy. On the local arrangements and entertainment committee are C. I. Gunness, chairman, W. T. Ackerman, F. W. Knipe, and G. E. Simmons.

Suggestions on the program will be appreciated and given every consideration if sent promptly to B. B. Robb, Department of Rural Engineering, Cornell University, Ithaca, New York.

American Standards Association

THE Standards Council of the American Standards Association at a recent meeting approved the starting of a new project on standard specifications for plastering, to be established under the joint sponsorship of the American Institute of Architects and the American Society for Testing Materials. The tentative scope of the project includes specifications for lime, gypsum and cement plastering for interior work (not for exterior work or stucco).

The American Society for Testing Materials has submitted two new projects for approval by the A.S.A. under the proprietary standards method: Test for organic impurities in sands for concrete (A 44) and test for sieve analysis of aggregates for concrete (A 45).

The standards for tool holder shanks and tool post openings (B 5b-1929) have been approved as an American Standard by the A.S.A. The standard covers tool holding and work holding elements of machine tools, such as tee slots, spindle noses, machine tapers, and small tools associated therewith.

The proposed American Recommended Practice for the inspection of gears (B 6g) was recently approved by a subcommittee of the sectional committee on the standardization of gears, and copies of the draft proposal are being circulated by the sponsors for review and criticism. A copy will be loaned to anyone interested by the A.S.A. Information Service (29 West 39th Street, New York, N. Y.).

The standard for cast iron long turn sprinkler fittings (screwed and flanged) for maximum hydraulic working pressures of 150 and 250 pounds per square inch (gage) (B 16g-1929) has been approved as American standard. It covers dimensional standardization (exclusive of screw threads) and designation of materials for pipe flanges and flanged screwed fittings for pipes carrying steam, gas, air, ammonia, water, etc.

At the suggestion of a group of manufacturers the sectional committee on bolt nut and rivet proportions has added the standardization of socket head cap screws to its program.

The American Society of Mechanical Engineers, sponsor for the standardization project "Code for Pressure Piping" (B 31) is distributing for criticism prior to final approval by the sectional committee a draft of Section IV of the code on gas and air piping systems (B 31C). This section covers the design, manufacture, installation and tests of gas and air piping systems, with the exception of piping used for conveying steam, refrigerants, gas in oil refineries, sewer gas, and ducts, such as those for waste gases and ventilation. Copies of the draft are available for criticism.

The Standards Council of the A.S.A. has approved the standardization project "Stock Sizes, Shapes and Lengths for Hot and Cold Finished Iron and Steel Bars" (B 41), to include rounds, squares, triangular sections, hexagons, octagons, half rounds, square-edge flats, but steel flats, beveled corner squares, round cornered squares, and including tolerances on cross-sectional dimensions of such bars to the extent that nationally recognized standards therefor are not available.

Three sections of the code on protection against lightning (C 5) have been approved by American Standards Association as follows: Part I—Protection of persons (C 5a-1929); Part II—Protection of buildings and miscellaneous property (C 5b-1929); Part III—Protection of structures containing inflammable liquids and gases (C 5c-1929). Parts I and II were approved as American Standard, and Part III as American Tentative Standard.

The American Tentative Standard for Aeronautical Symbols (Z 10e-1929) and American Standard for Letter Symbols for Electrical Quantities (Z 10gl-1929) have now been received from the printer and are available for sale by the A.S.A. at 35 cents and 20 cents, respectively. They are also available for loan to anyone who wishes to review them.

Rural Electrification Short Course Held in Virginia

VIRGINIA is the most recent addition to the growing list of states which offer an annual short-course in rural electrification. The first of these courses in Virginia was held at Virginia Polytechnic Institute, Blacksburg, June 12-14, through the cooperation of the agricultural engineering department of the Institute, the Public Utilities Association of Virginia, the National Electric Light Association and the electrical equipment manufacturing companies.

At its first session Dr. Julian A. Burruss, president of Virginia Polytechnic Institute, welcomed the class and Chas. E. Seitz, head of the agricultural engineering department, opened the three days of intensive study with a review of rural electric progress in the state.

Such well-known figures in rural electrification as Dr. E. A. White, Geo. W. Kable, Miss Eloise Davison, W. C. Brown, J. E. Waggoner and J. W. Savage (all A.S.A.E. members) were among those from out of the state who had places on the program.

"Electric Power as a Logical Development in American Agriculture," by Mr. Kable, and "Rural Electrification in the United States," by Dr. White, were broadening departures from the usual shop talk of rural electric specialists. Among the other features were "How Can the County Agent Assist in the Rural Electrification Movement?" by John R. Hutcheson, director, extension division, Virginia Polytechnic Institute; "Irrigation by Electricity," by W. H. Coles, president, Skinner Irrigation Company; "Peak Loads on the Farm" by Mr. Kable; and "Cooperation of Individual Light Plant Dealers and Electric Utility Companies," by J. E. Waggoner, public relations department, Delco-Light Company. Extension of lines, contracts and rates, line construction, home equipment, farm lighting, water systems, farm motors, feed grinding equipment, electricity in the dairy and poultry industries, and methods of merchandising electrical equipment drew the usual amount of attention. Movies, inspection trips, demonstrations and a group dinner added variety to the program.

Russian Publication on Agricultural Engineering

THE Bureau of Information, Section of Agricultural Engineering, Supreme Council of National Economy, 3 — Miasnitzkaia, Moscow, U.S.S.R., has had printed in English a list of publications containing the transactions of the scientific and technical institutions of Russia. A copy of this list will be sent to those interested on request to this address.

Personals of A.S.A.E. Members

Hobart Beresford, head of the department of agricultural engineering, University of Idaho, and secretary and project director of the Idaho Committee on the Relation of Electricity to Agriculture, Moscow, is author of Progress Report No. 5, dealing with the development of rural electrification in connection with the Idaho project during 1928.

J. B. Davidson, professor of agricultural engineering, Iowa State College, has been appointed a member of an American commission to visit Russia and Siberia this summer to report on a colonization project in which it is proposed to colonize Jewish peasants now in European Russia in the Amur Valley in southeastern Siberia. A large tract of land has been set aside for the project. The commission, of which Dr. F. S. Harris, president of Brigham Young University, is president, will do its work under the auspices of the ICOR Society of America.